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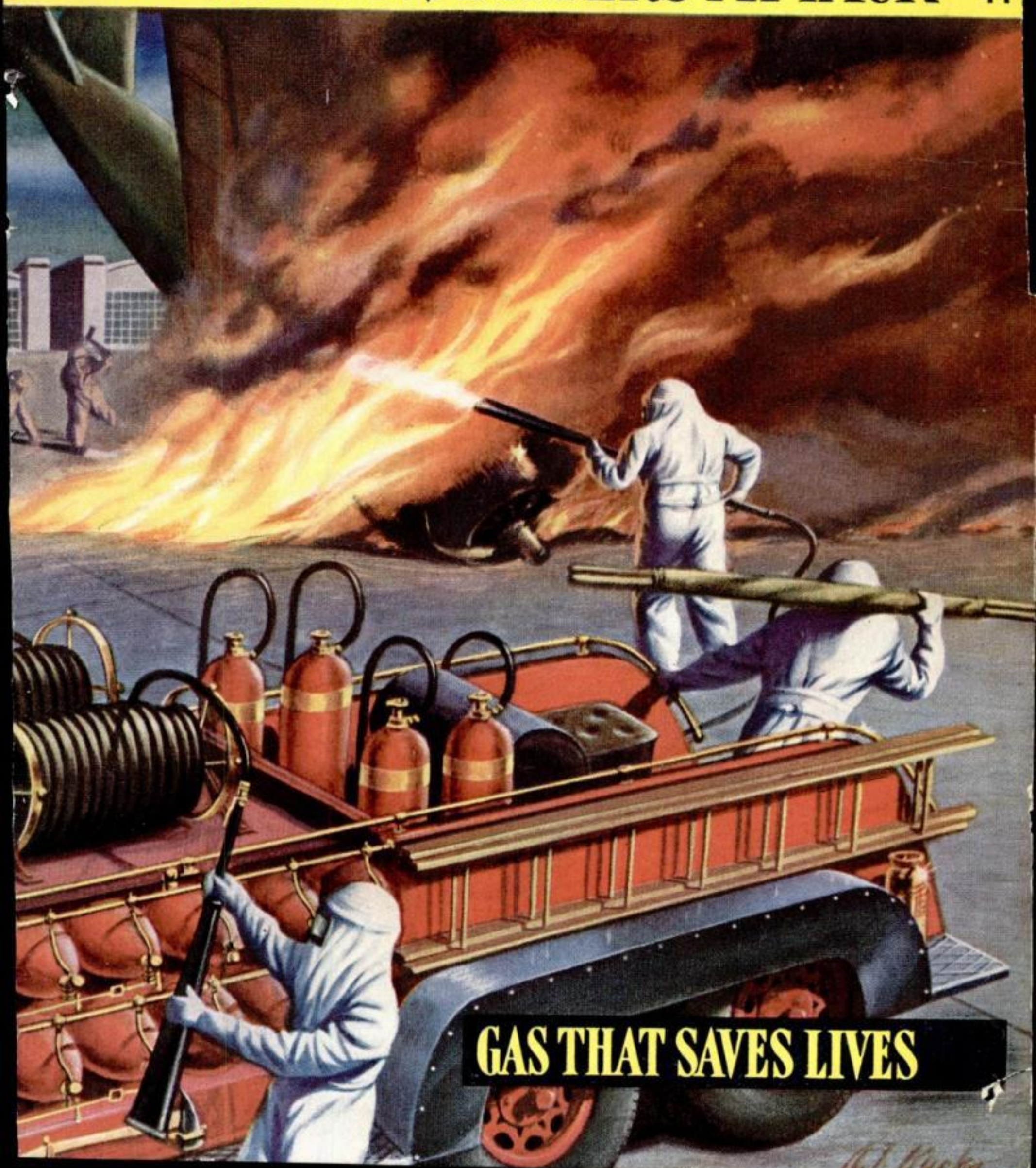

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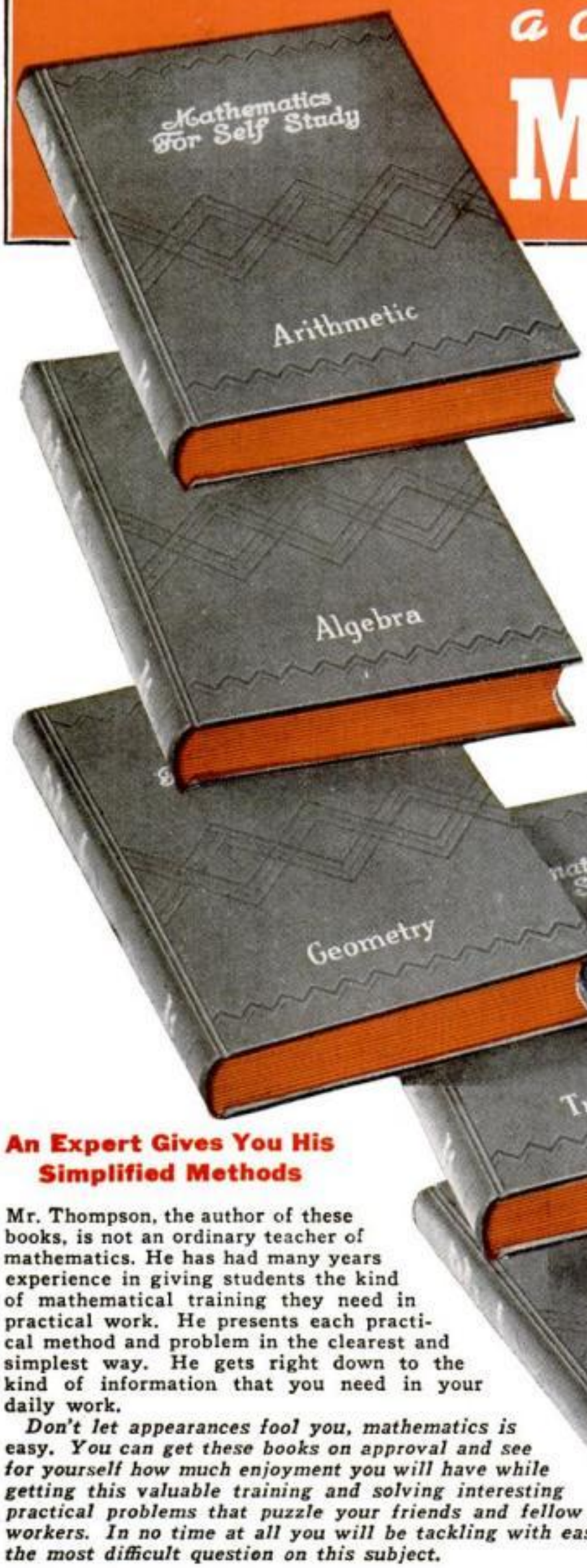

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Mechanics & Handicraft

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Home and Workshop Pages Given New Numbers for Easy Reference

IF YOU will turn to the beginning of our Home and Workshop Department, you will find an innovation in numbering the pages. Instead of being marked 145, 146, 147, they are numbered HW 1, HW 2, HW 3, and so on to HW 64. "HW," of course, stands for Home and Workshop. Next month the numbering will be continued with pages HW 65, HW 66, HW 67, and so on. In August the pages will be numbered from HW 129 to HW 192, and the system will be followed to the end of our indexing period, whereupon the numbering will start over again with HW 1, HW 2, HW 3.

The change is being made for greater convenience in referring to articles in the Home and Workshop Department, which contains much reference material that readers are in the habit of saving for future use. It is, in fact, the same reason that has made it necessary for many years to issue a special annual index for the Home and Workshop.

We hope that our readers, particularly those who have sent us helpful suggestions in regard to the arrangement of that department, will approve the new numbering system. The department itself will, of course, remain unchanged. It has appeared in Popular Science without interruption for a quarter of a century.

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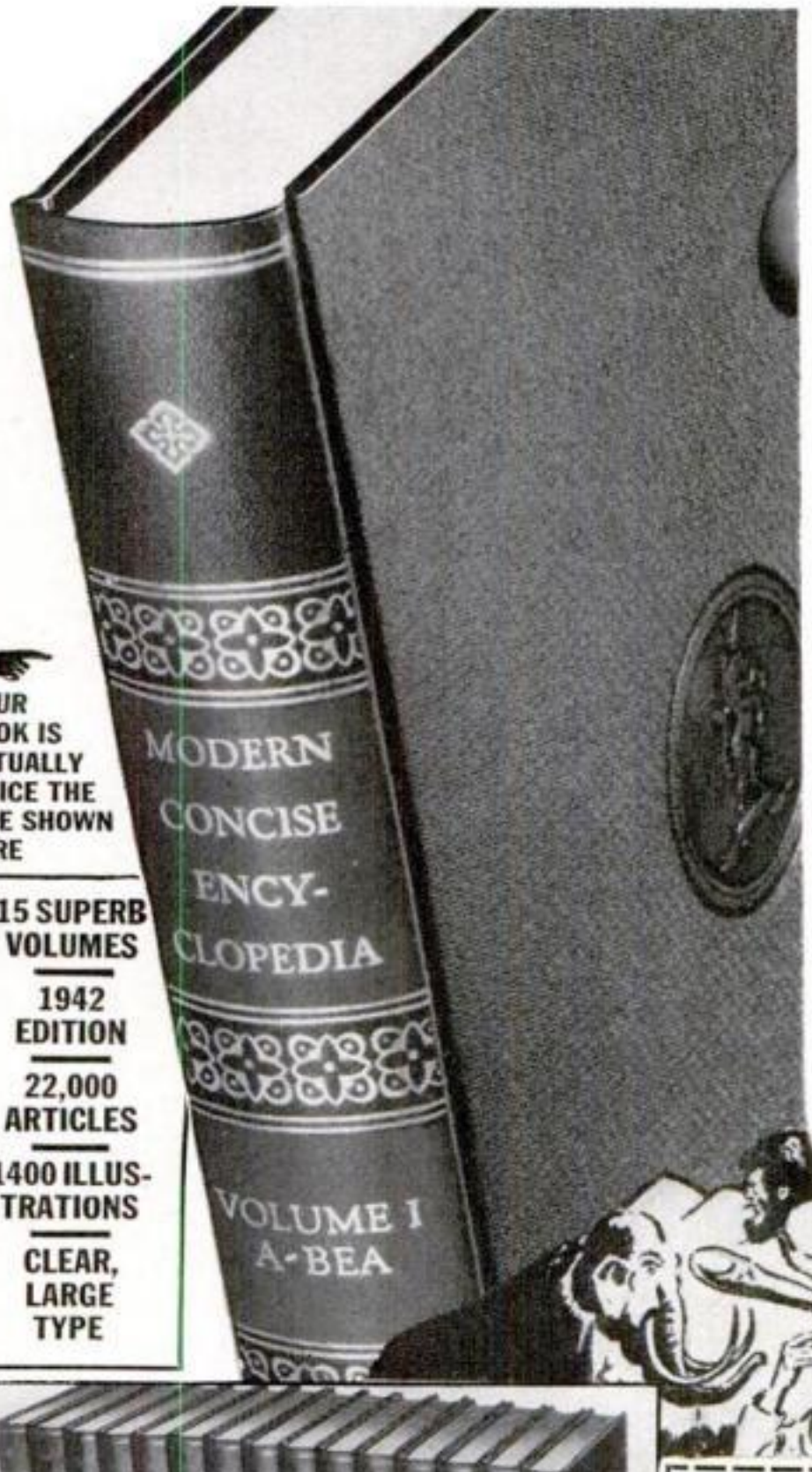

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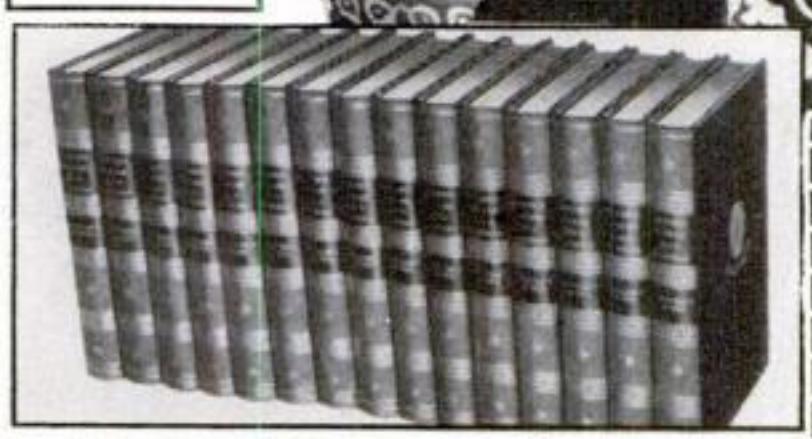

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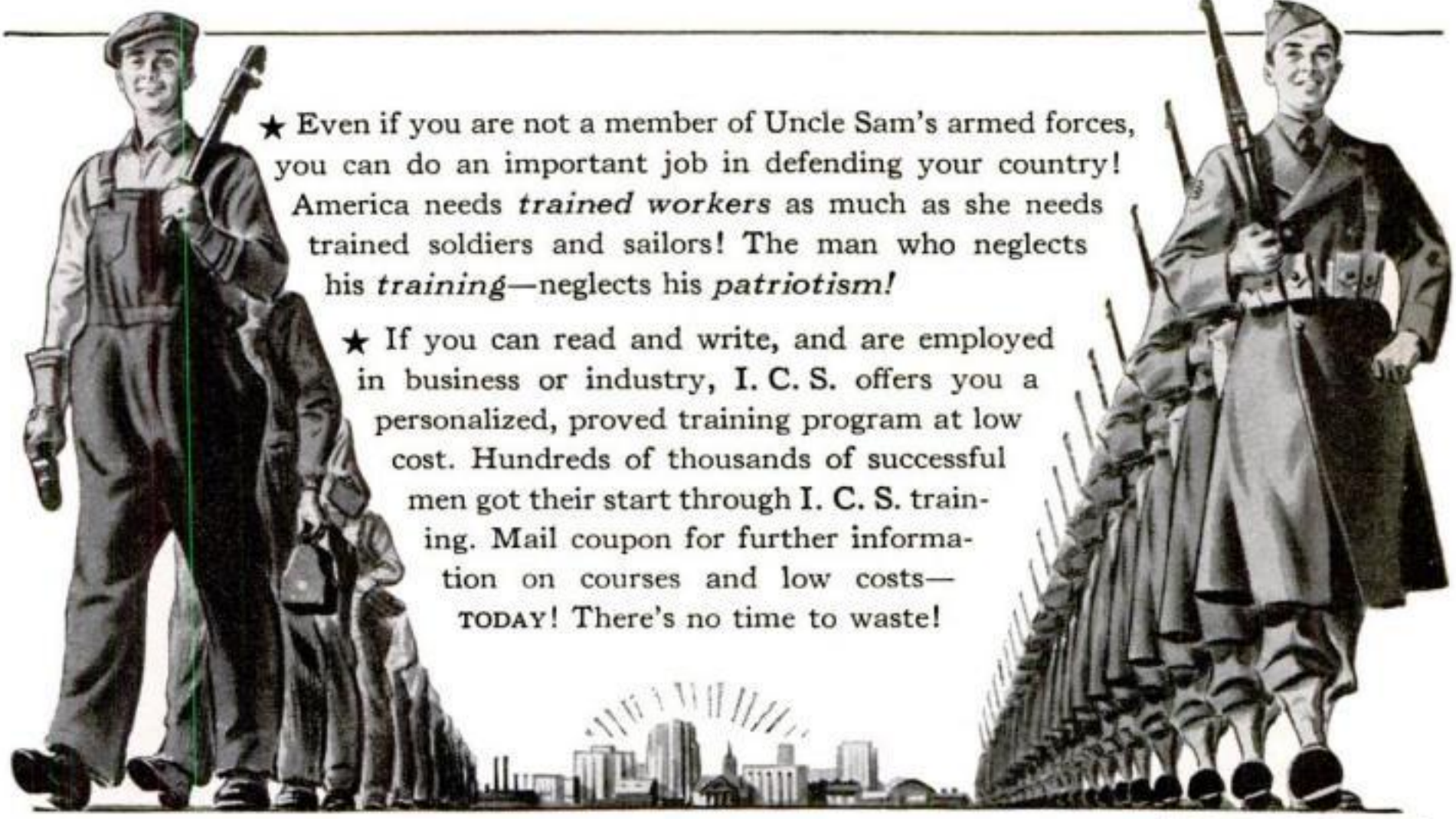

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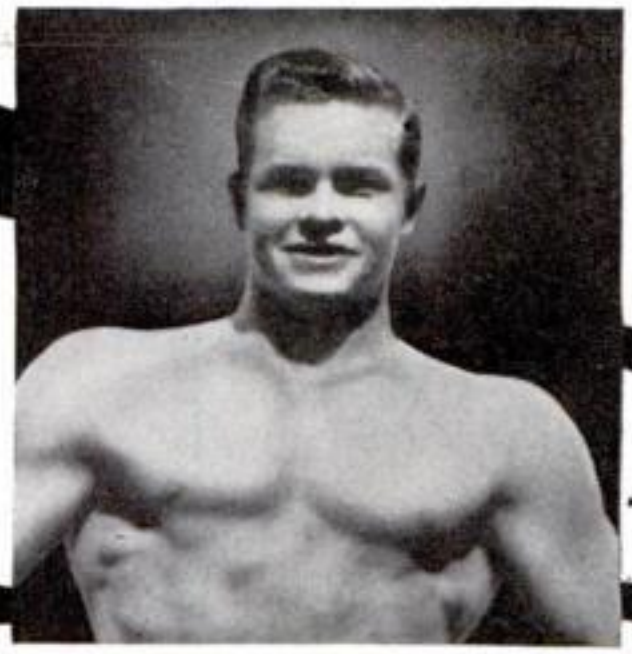
WHAT GOES ON in a big U. S. Army bomber as it wings toward its target? How are the various members of its picked crew trained to work together in their desperate game with death? Hickman Powell tells you about the teamwork that puts the teeth in our Flying Fortresses and other types of bombing planes as they harry the enemies of democracy.

HE Mailed This Coupon



J. G. O'BRIEN
Atlas Champion Cup Winner

This is an ordinary snapshot of one of Charles Atlas' Californian pupils.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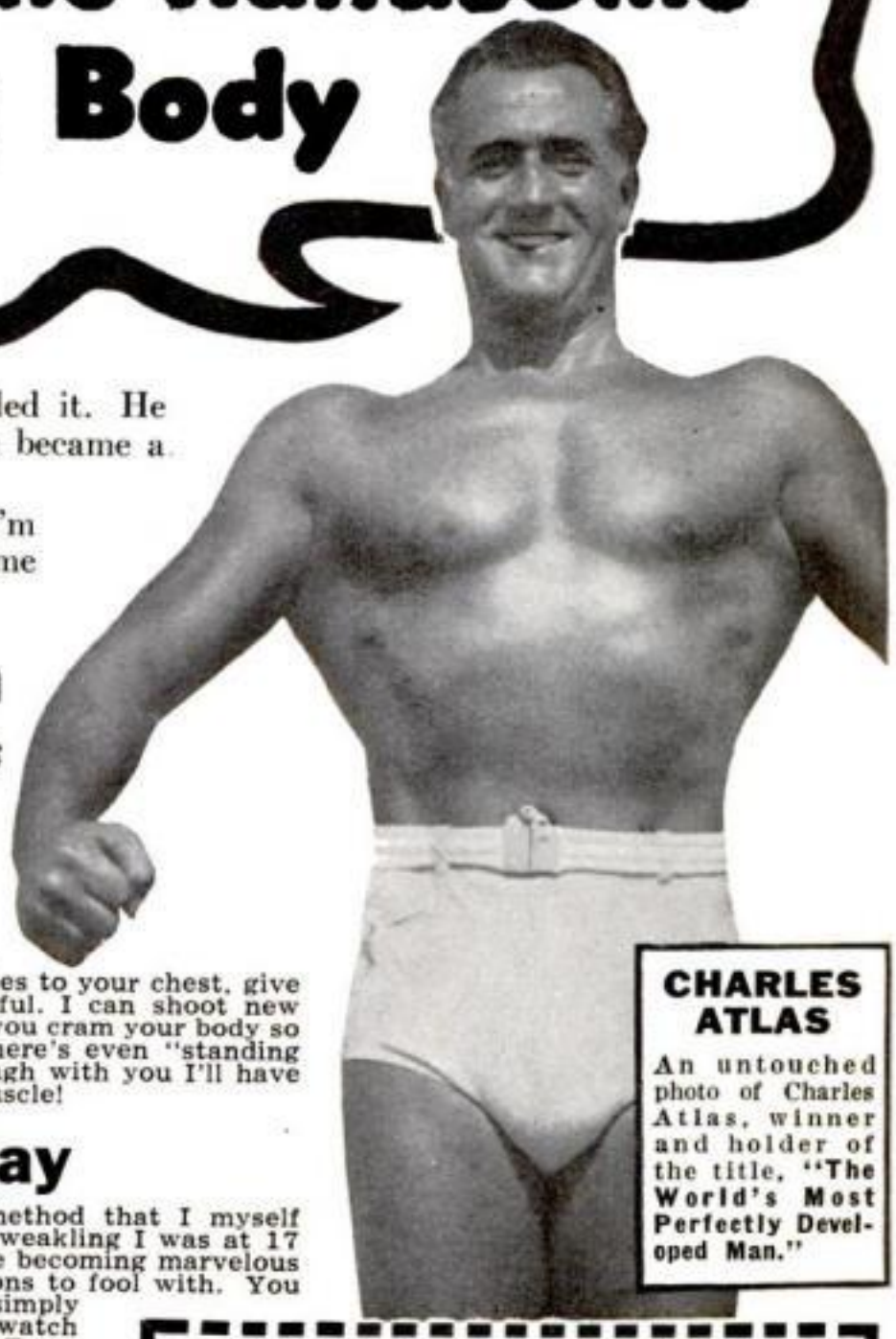

J. G. O'BRIEN saw my coupon. He clipped and mailed it. He got my free book and followed my instructions. He became a New Man. NOW read what he says:

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I don't care how old or young you are, or how ashamed of your present physical condition you may be. If you can simply raise your arm and flex it I can add SOLID MUSCLE to your biceps—yes, on each arm—in double-quick time! Only 15 minutes a day—right in your own home—is all the time I ask of you! And there's no cost if I fail.

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From the News Editor's Desk

TO GIVE SURGEONS a better idea of the type of wounds encountered in the present war, a new branch of the Army Medical Museum at Washington, D. C., has been opened that will act as a collecting center for specimens and models of injuries peculiar to present combat conditions. The museum will also serve as a recruiting center for clinical photographers and medical artists who can serve with expeditionary forces and in Army hospitals.

FRESHNESS AND FLAVOR can be kept in food by freezing it with a new machine, recently developed at the University of Texas, which is said to be four times as fast as any previously used. Known as flash-freezing, the new method consists of immersing foods in a solution of sugar or salt which is so adjusted as to temperature and concentration that it will contain all three states of matter—solid, liquid, and vapor. By agitation and cooling, minute ice crystals are formed throughout the liquid which so increase the heat conductivity of the mixture that heat is carried away from the immersed food twice as rapidly as by any other liquid at the same temperature. Investigators found that with the composition at minus 10 degrees F., freezing occurred four times as fast as with the sirup used in other quick-freezing methods.

PLASTIC POLAROID GOGGLES which enable airplane pilots to accustom their eyes to darkness before a night patrol have been perfected by the Medical Research Section of the Bureau of Aeronautics. Originally devised for the Navy, the goggles are equipped with special lenses which allow only a small amount of light to reach the portion of the retina which is used to see in the dark, yet permit the pilot normal vision with the rest of the eye. Before the goggles were designed, pilots on night duty either had to fly blind for 20 or 30 minutes or first sit in a darkened room until their eyes accommodated themselves.

DYE-MARKING WILD SQUIRRELS in vivid hues of orange, purple, and yellow is the newest method of enabling scientists to watch the habits of these small animals. The technique was developed by W. D. Fitzwater, Jr., of the Connecticut State Board of Fisheries and Game, who claims that zoölogists will now be able to keep better track of the marked squirrels and identify them if they stray from their customary range.

EXTRACTING THE MEAT-TENDERIZING FACTOR from raw pineapple can now be done inexpensively by means of a new process. Knowing that bromelin, an enzyme that breaks down meat protein, was present in raw pineapple juice, scientists in the U. S. Department of Agriculture developed a method of extracting this enzyme from peels and cores of the fruit. The method consists of precipitating the bromelin with alcohol from juice pressed from the peels and cores in a stage of manufacture where the juice is of little value to the canner. The alcohol can be recovered and used again with more juice.

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Readers Say:

Sometimes the Easy Way Is Also the Best Way

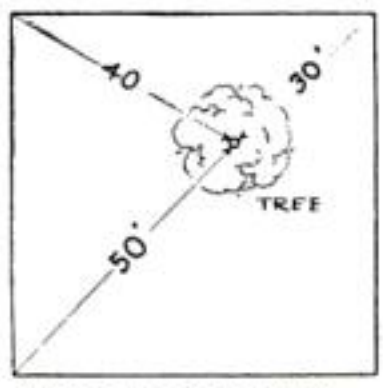
J. E.'s PROBLEM about the two warships and the speedboat is quite simple if you go at it the right way. It reminded me of an article you published many years ago, in which you told of an intelligence test given to Army officers. One problem stated that two cyclists started ten miles apart and rode toward each other at the rate of five miles an hour. A crow started at the same time with one of them and flew back and forth between them at 15 miles an hour until they met. The problem was to find how far the crow flew, and you told of one officer who tackled it the hard way—with a slide rule—and obtained an answer of 14.999 miles or thereabouts.—K. D. F., Canton, Ohio.

Watchmaker Wants to Build Listening Device for Ticks

THIS is the first favor I have asked of you in the many years I have been reading your valuable magazine. I am a watchmaker of 31 years' standing, and my hearing is not quite as good as it used to be. I want to ask your radio department to design a listening device that men like myself can make up and have on our workbenches to listen to the ticking of these small wrist watches. It should consist of a small microphone inclosed in a sponge-rubber-lined box that can be closed so as to keep out all surface noises. A single headset will do nicely. I think the device should be battery-operated so as to cut out all hum, and it should be small so as to not take up too much space on our workbenches. If you will give this some thought, you will be doing the watchmakers of my age in this country a great favor.—J. S. C., Columbus, Ohio.

What Was an Ingenious Man Doing with a Steel Tape Like That?

HERE is a problem that might be of interest to your puzzle fans: A farmer had a square piece of land with a single tree on it. He had also a steel tape 50 feet long that was graduated in ten-foot sections. Trying to measure his piece of land, he found that the tape was not long enough to cover one side, and also that the side would not measure out exactly on one of the ten-foot sections. Now, being an ingenious man, he measured from a point on the base of the tree to three of the corners. Lo and behold, the distances came out to be exactly 30, 40, and 50 feet. Now the problem for you and Joe Farmer is to find the area of his square plot.—J. A., Los Angeles, Calif.



What to Do with Old Batteries Is Next on the Program

YOU have answered a lot of questions from readers who wanted to know what they could do with various things. I wonder if anyone could tell me what to do with old portable-radio batteries, flashlight batteries, and six-volt dry cells?—C. W. F., Walnut, Ill.

Wanted: A Portable Short-Wave Receiver for Civilian Defense

FOR the benefit of air-raid wardens and other civilian defense workers, I should like to see you publish a hook-up for a short-wave radio similar to the portable broadcast circuit published in your issue of September 1940. This would be very helpful to members of defense organizations for keeping in touch with police radios for instructions. Of course, the set should be as small as possible, and be powered with small batteries so that it could be carried in a pocket. I believe this would be a real service to the cause of civilian defense.—R. A. S., San Antonio, Tex.

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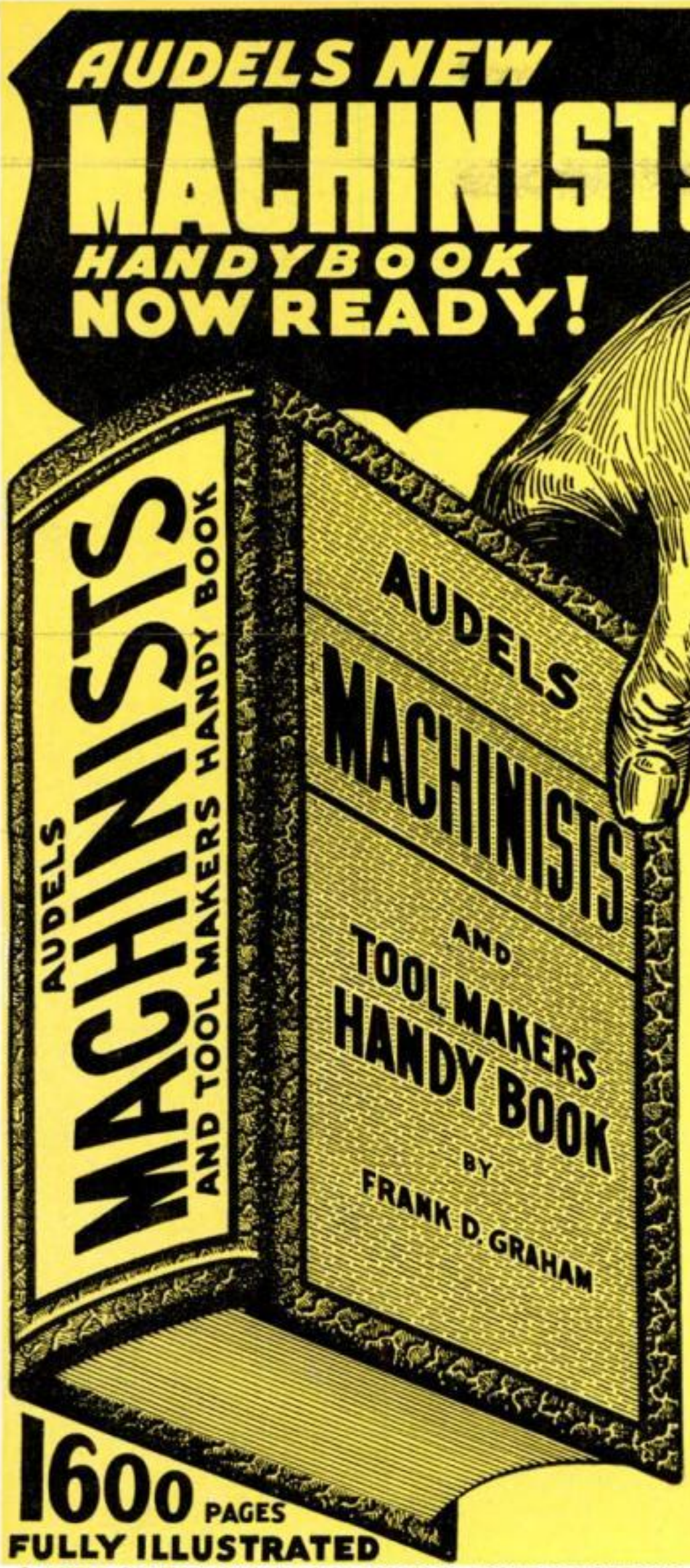

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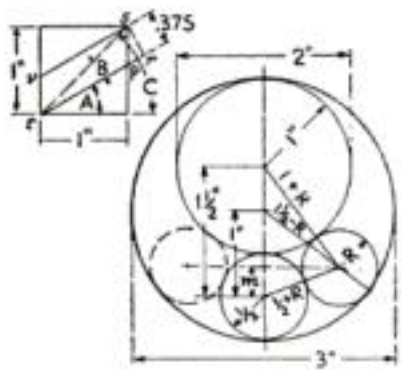
Readers Say:

Sorry We Couldn't Publish ALL the Answers on This



The angle in the problem of the square submitted by D. K. G., of Seattle, Wash., may be solved by extending the line tp indefinitely and dropping a perpendicular sr from the corner of the square. Then the sine of angle B equals .375 divided by the square root of 2. Angle C equals 45 degrees, and angle A equals 45 degrees minus angle B, which I compute as 29 degrees 37 minutes and 27½ seconds. That circle problem is an interesting thing. By connecting the centers of the circles as shown, it can be proved by geometry that

$$m = \frac{(\frac{1}{2}+R)^2 + 1 - (1\frac{1}{2}-R)^2}{2}$$

also that

$$m = \frac{(\frac{1}{2}+R)^2 + (1\frac{1}{2})^2 - (1+R)^2}{3}$$

Now since both these expressions are equal to m they are equal to each other

$$\frac{(\frac{1}{2}+R)^2+1-(1\frac{1}{2}-R)^2}{2} = \frac{(\frac{1}{2}+R)^2+(1\frac{1}{2})^2-(1+R)^2}{3}$$

Solving this equation for R, we get 3/7; therefore the diameter equals 6/7. If D. K. G., or any other reader desires a shorter formula, I suggest that the radius of the circle may be found thus:

$$R = \frac{L^2S+LS^2}{L^2+LS+S^2}$$

when L equals the radius of the larger of the two inscribed circles of known dimensions and S equals the radius of the smaller. Perhaps our friend, D. K. G., can give me a formula for the next pair of circles in the same series.—G. W. F., Liverpool, N. Y.

CORRECTION

In our digest of the book "A Lot of Insects" by Dr. Frank E. Lutz, in our April issue, we erroneously stated that the book was published by The Cornwall Press. The publishers are G. P. Putnam's Sons, New York.

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Readers Say:

An Electrician Testifies to Danger of Overfusing

AS AN electrician, I was interested in the article by Harold P. Strand on the new tamperproof fuses. His illustrations are very plain, even to the uninitiated layman. In the past, whenever I finished a job of house wiring, I always installed the proper fuses and called the home owner's attention to the danger of overfusing. In some cases I would go back later and find part or all the fuses replaced with the 30-ampere size. At least twice I have seen the starting winding of a split-phase motor burned out, owing to overfusing, when the washing machine on which it was installed became jammed and no one was there to shut it off in time. A 15-ampere fuse would have blown before any damage was done to the motor.—W. M. V., Bonfield, Ill.

P.S.M. in Dentist's Office Was a Local Anesthetic

ONE day when I was in my dentist's office, I happened to pick up a copy of Popular Science (July 1940) which made me forget all about the pain I was to endure, and I have been buying it every month since then. I find in it almost anything I want, and as I have no encyclopedia at present, when I want to find out something I just haul out old P.S.M. and I usually find what I am looking for. I have been looking forward to the printing of a spotters' guide to all the warplanes of the Axis, and our own, so we citizens can tell them apart. Outside of that, all I can say is, "Keep up the good work!"—W. E. J., Orlando, Fla.

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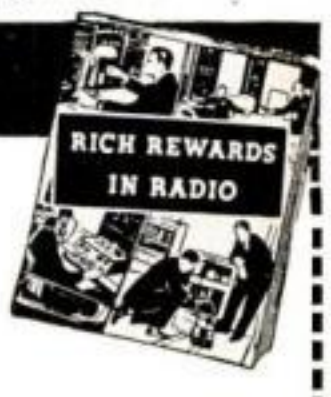

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(Continued on page 22)

Plans for the Workshop

(Continued from page 20)

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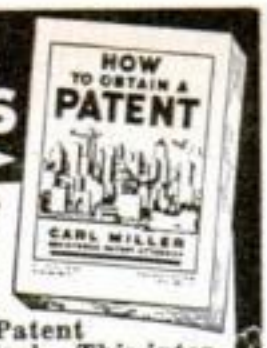

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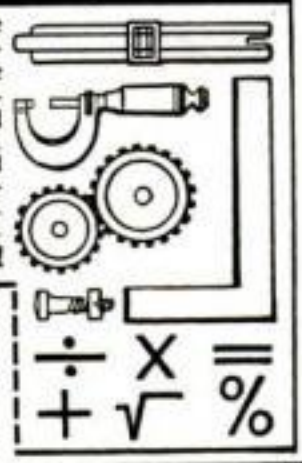

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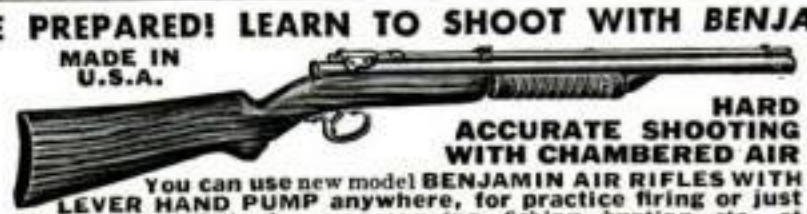

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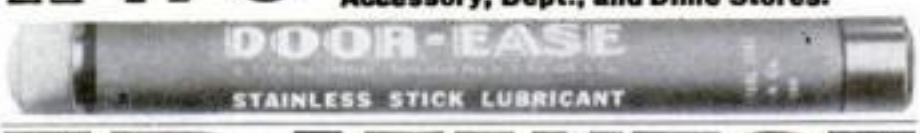

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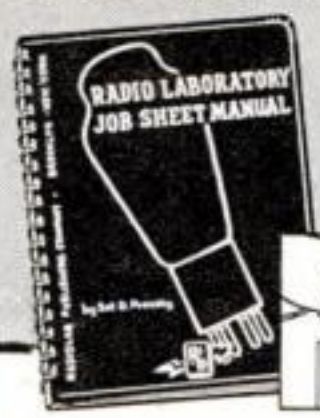

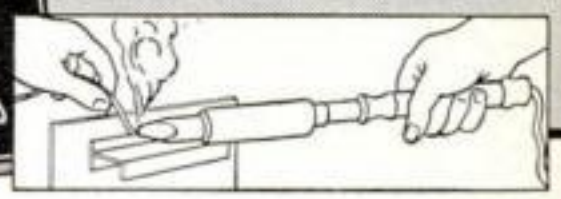

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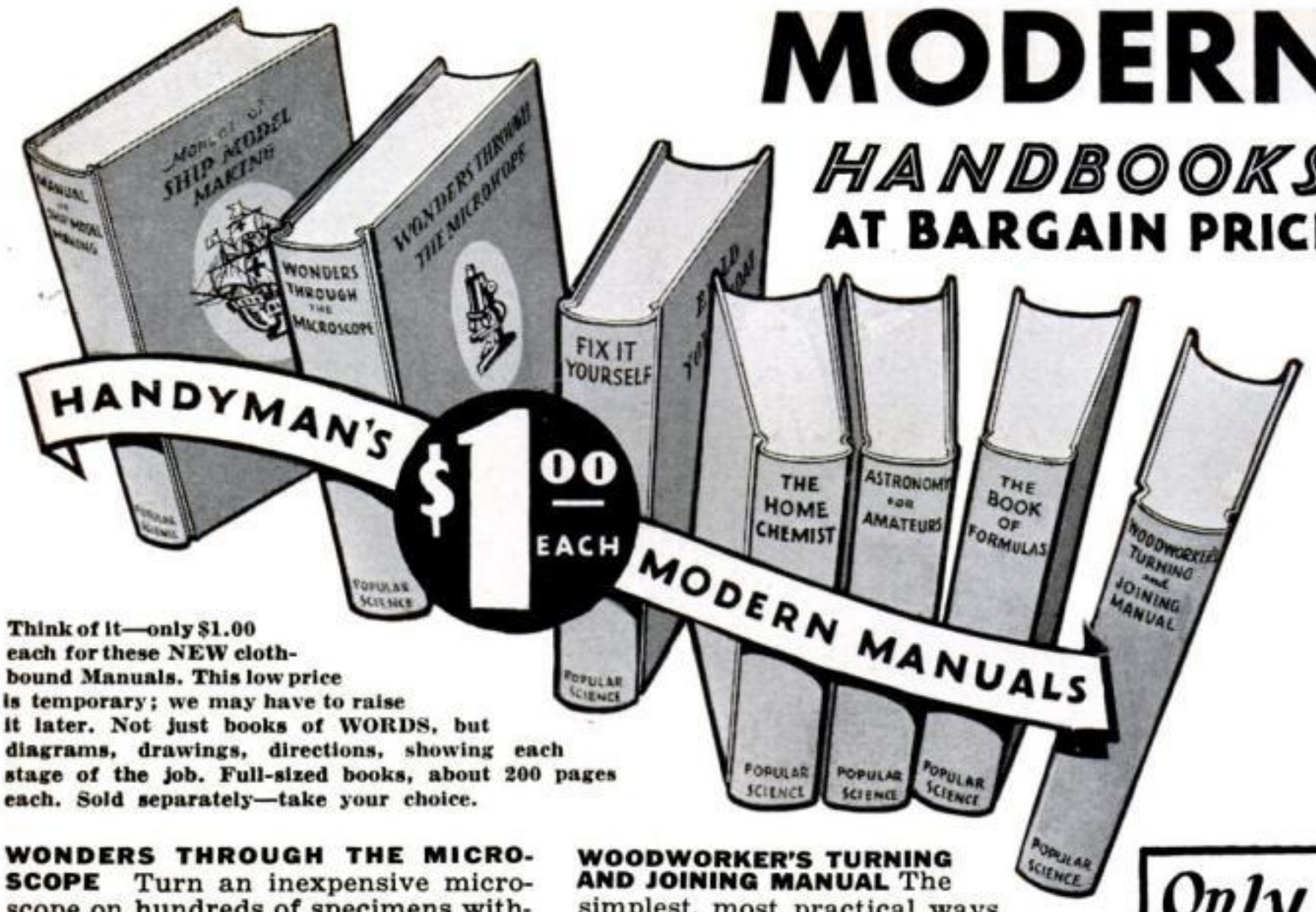

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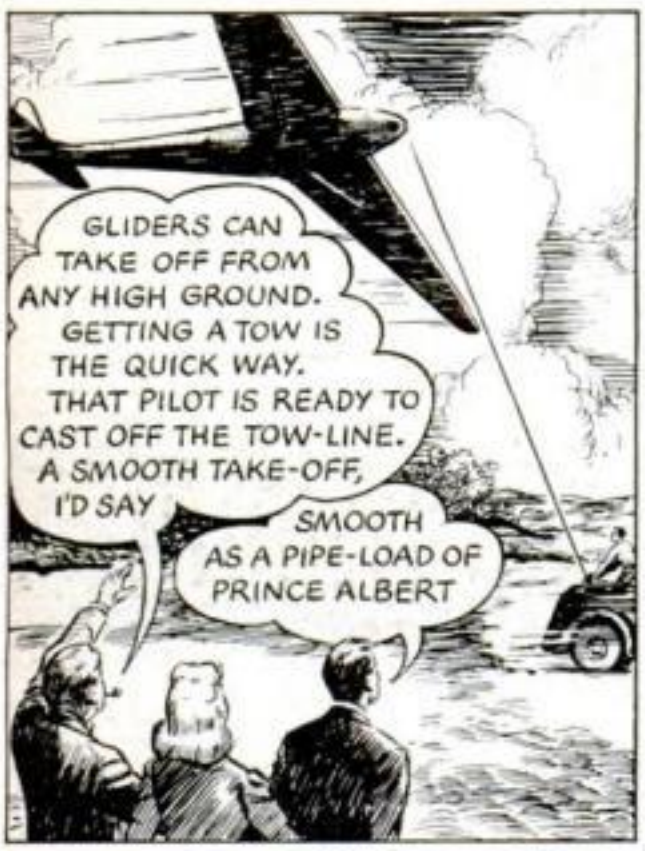
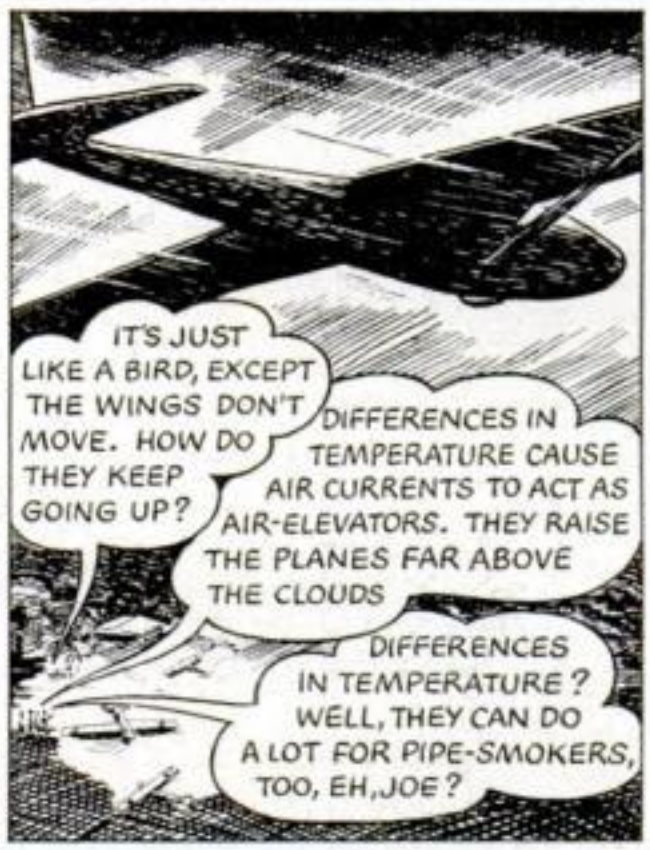
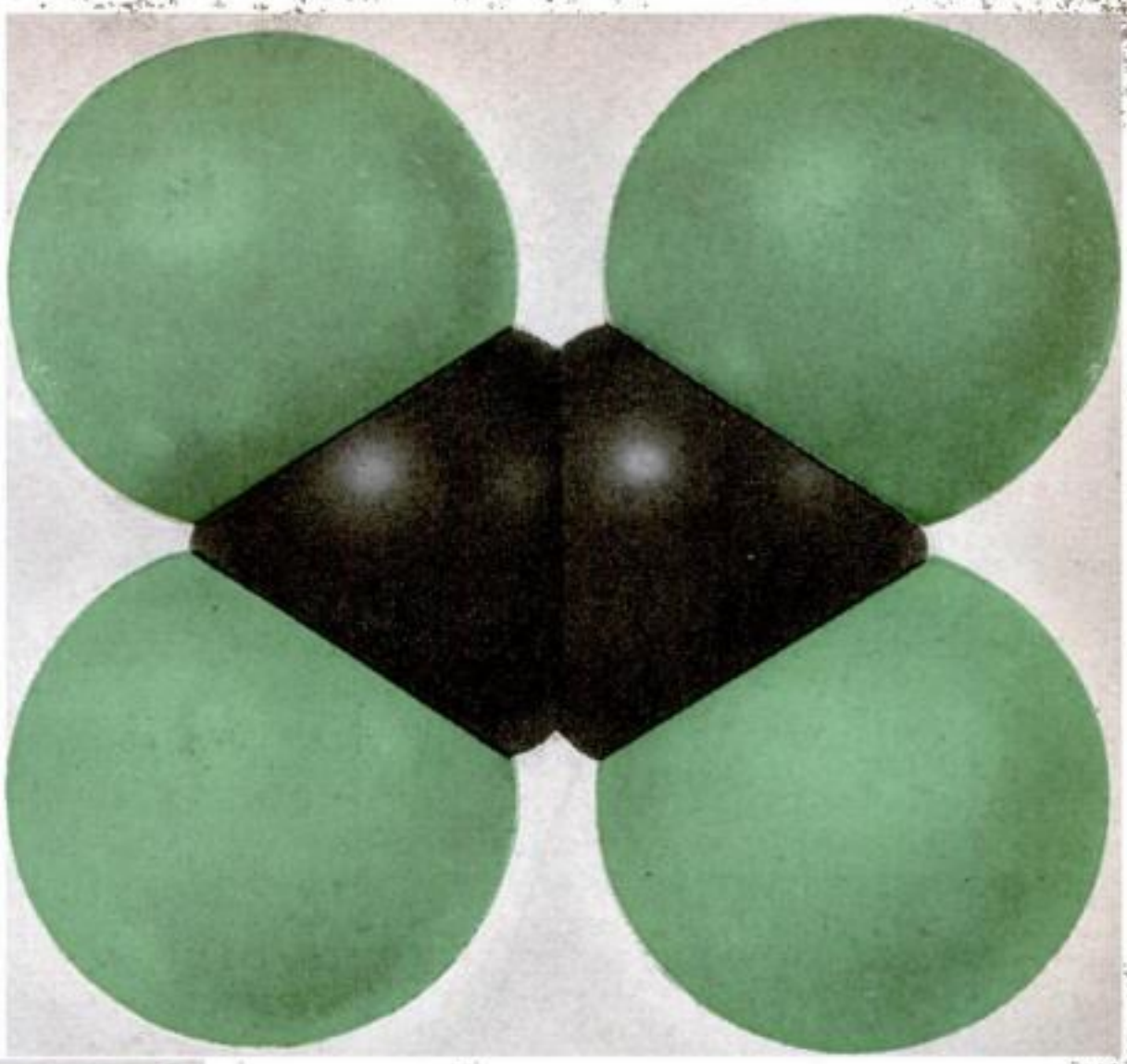






TWO ATOMS OF CARBON (BLACK) AND FOUR OF CHLORINE JOINED IN A MODEL MOLECULE OF TETRACHLORETHYLENE, MADE WITH "BUILDING BLOCKS" THAT HELP A CHEMIST TO ANALYZE MOLECULAR STRUCTURE, SYNTHESIZE COMPOUNDS

Assembling a molecule model. "Atoms" are joined by pegs in holes representing valence, so it is impossible to join two atoms that do not really combine

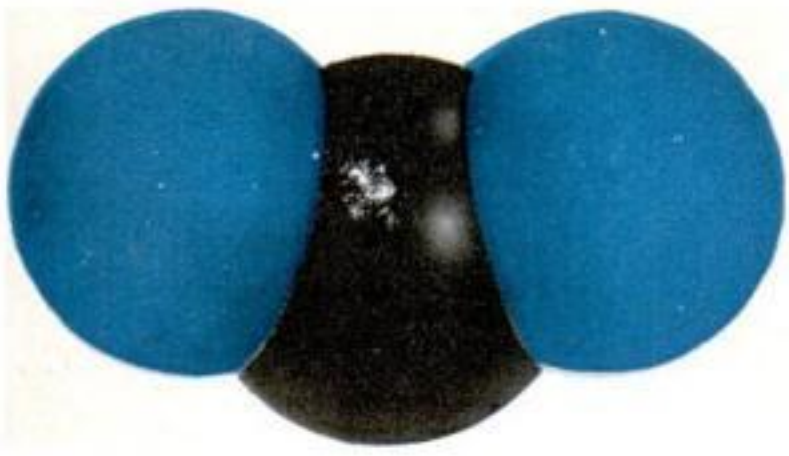
MODELING WITH MOLECULES

By KENNETH M. SWEZEY

BRIGHTLY colored "building blocks," atom models with which chemistry students and top-ranking chemical researchers alike can construct three-dimensional models of molecules of thousands of organic compounds, are science's newest aid to the study of molecular structure.

Scaled accurately to 100,000,000 times "life size"—one centimeter in the model representing one angstrom unit in the original—the models can be measured with an ordinary meter stick for instant determination of the size of the corresponding real atoms or molecules. With angles of joining and distances between atom centers in strict accordance with latest scientific findings, the models help the creative chemist in synthesizing new compounds.

Until a few years ago, knowledge of the



A MOLECULE OF CARBON DIOXIDE: ONE ATOM OF CARBON, TWO OF OXYGEN

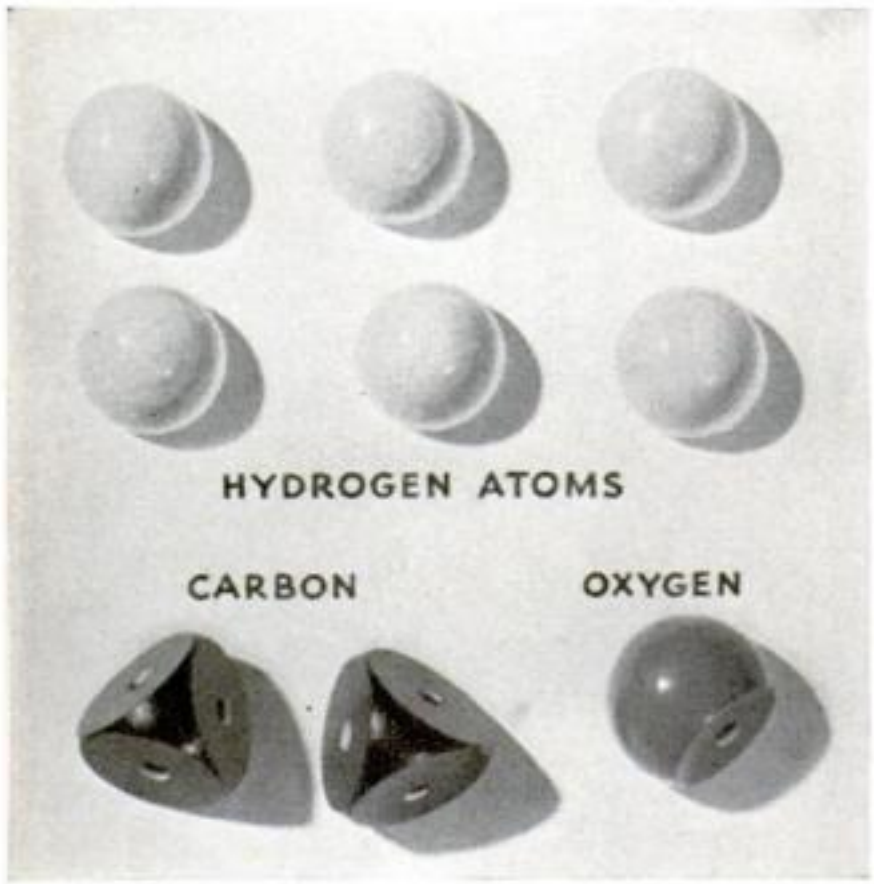
architecture of organic molecules was not sufficiently complete to permit accurate representation. Models, therefore, were comparatively crude, showing only the various atoms and, vaguely, their relationship.

The invention of electron-diffraction apparatus in 1930 provided a new tool for studying the structure of these ultramicroscopic units of matter. With this apparatus a narrow, well-defined beam of electrons is shot through a fine jet of a gas whose molecules are to be investigated. The dense nuclei of the atoms in the gas molecules scatter the electrons in a definite pattern, which is recorded on a photographic plate. From this pattern a chemist is able to deduce the internuclear distances—distances between the centers of atoms—and the angles at which the atoms attach themselves.

Investigation of some 500 compounds by electron diffraction revealed that the different forms of building blocks required to make them were surprisingly few. In fact, most organic compounds could be represented accurately by molecule models built up from less than two dozen kinds and shapes of atom models.

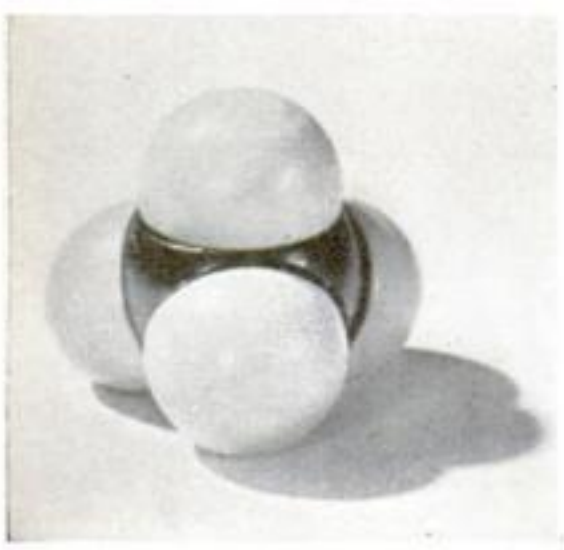
The new atom models shown here—available to schools, students, and chemists in kit form—are based on these investigations. They were developed into their present practical form by Dr. Joseph O. Hirschfelder, of the Department of Chemistry of the University of Wisconsin, in collaboration with the Fisher Scientific Company.

Models of each element are finished in a bright color distinctive of that element. Hydrogen, for instance, is orange; carbon, black; oxygen, light blue; sulphur, yellow; chlorine, green. Each atom is made by cutting one or more segments from a sphere, giving it one or more flat faces, against which it may be joined with other atoms. Single, double, and triple holes drilled in the faces indicate the valences, or the ability of the faces to unite with other atoms. The atoms are joined with brass pegs, and, because of the valence holes, it is impossible to join two atoms in the models that will not join in real molecules.

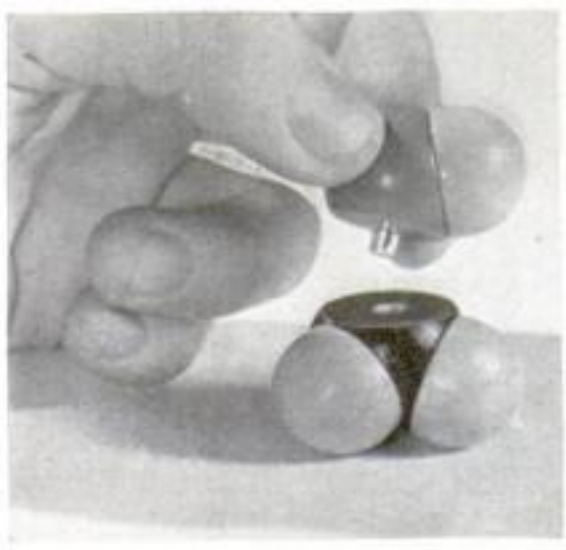


Using these nine atoms as building blocks, chemists can construct many organic compounds with widely different characteristics, as shown below

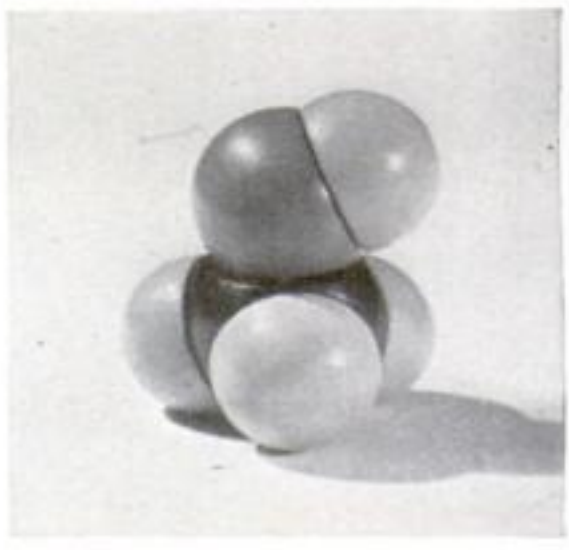
METHANE, or marsh gas, represented by a four-sided carbon atom joined to four hydrogens



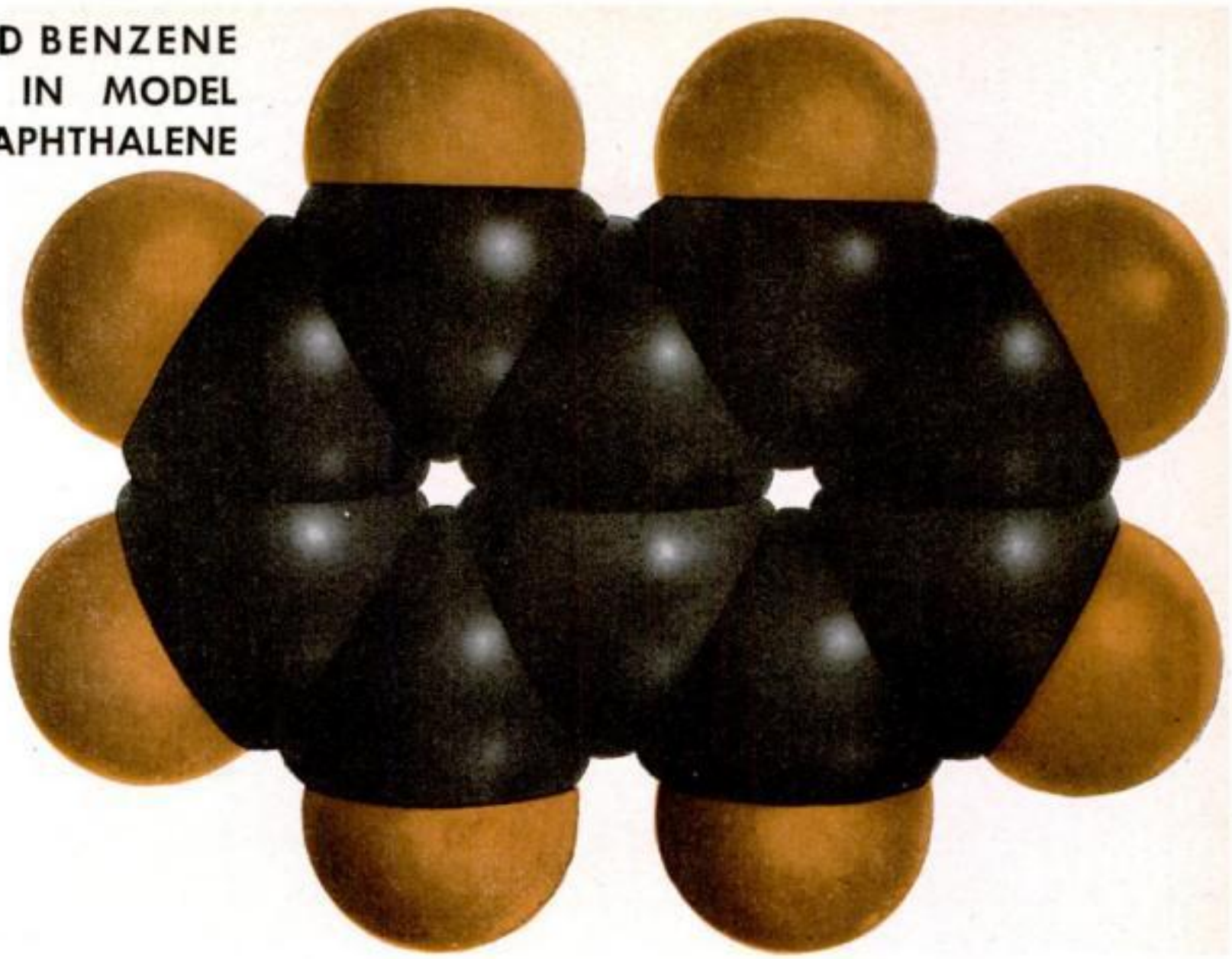
CHEMICAL MAGIC introduces an oxygen atom between the carbon atom and a hydrogen



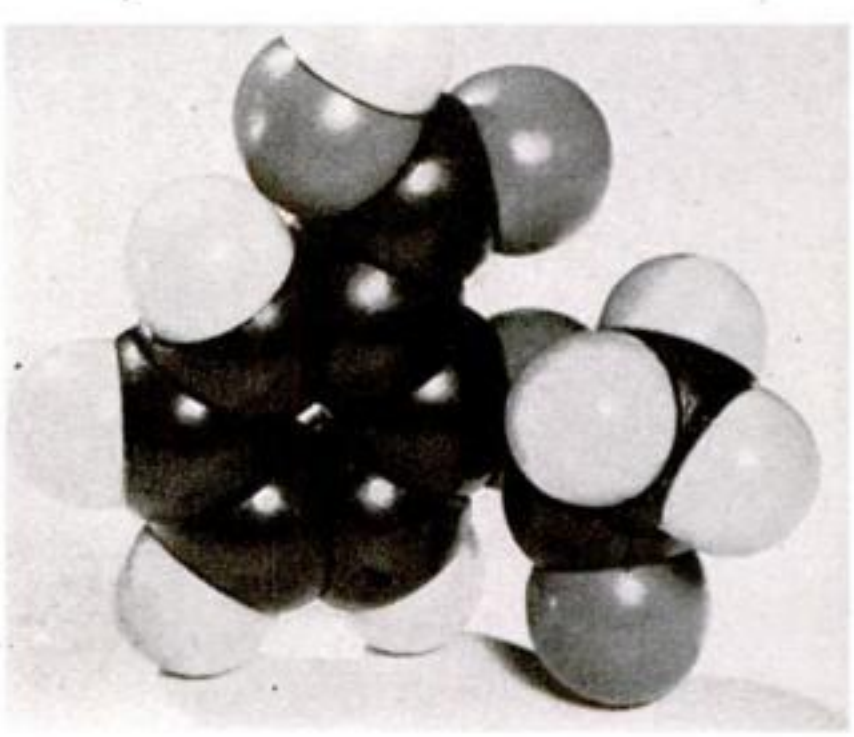
METHYL, or wood alcohol, is the result in a molecule model that looks like a funny little bird



LINKED BENZENE RINGS IN MODEL OF NAPHTHALENE

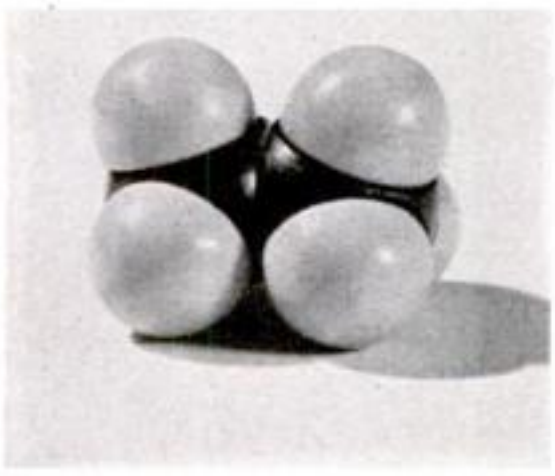


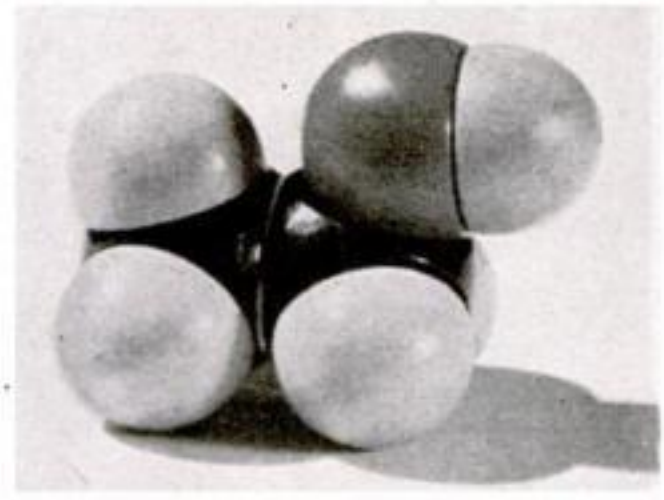
The complexity of the molecules which may be constructed with these atom models is limited only by the number of atoms available and the size of the workroom. One can make the simple gas methane, by attaching one hydrogen atom to each of the four sides of a tetrahedral carbon atom, or construct the complex molecules of vitamins, hormones, plastics, starch—some requiring hundreds and even thousands of atoms. Although the regular kit contains only 108 atoms, extras may be bought by the dozen. The only "blueprint" needed for construction is a structural formula supplied by any textbook or technical paper. So far, there are more than 300,000 formulas of organic compounds to choose from.



ASPIRIN, trusted remedy for headache, has a molecule based on the benzene ring of six carbon and six hydrogen atoms, found in benzene, naphthalene, and other organic compounds

ETHANE is the next step, when the bird's head is replaced by a carbon with three hydrogens





ETHYL ALCOHOL (the kind that gives you the headache) is a toy puppy-dog made by putting an oxygen atom between a carbon and a hydrogen atom in the ethane model

Dynamiters To The Attack

By HICKMAN POWELL

WHEN the tales of this war come to be told, the man with a satchel full of TNT will rank with the most dashing and intrepid of all its heroes. Whether he be parachutist, commando, or assault pioneer from the Corps of Engineers, he will be operating as a lone wolf or with a small squad of teammates; but there will be concentrated in him a tremendous share of the responsibility for success against the enemy.

"Demolition" is what the Army engineers call the old art of the dynamiter—the use of high explosives not in bombardment or artillery fire, but in charges placed by hand, right where they will do the most damage. One man with a few half-pound blocks of TNT (looking much like a bundle of oversize Eskimo pies) can raise more havoc, if he reaches the right spot, than a load of big bombs dropped in the vicinity.

The elements of demolition are part of the basic training of military engineers, and the subject covers the whole field of laying land mines, blowing craters to impede tanks, the wrecking of bridges, docks, and factories, and the reduction of fortified positions by direct personal assault.

Up to now, fighting a defensive war, we have had demolition much in mind as part of the scorched-earth tactics of armies in

Blowing a crater to block a road or make a tank trap is one of the specialties of the engineer demolition crews. First, a hole is drilled with a mobile power auger like the one shown below, or with hand tools. If the original hole is not large enough to take the charge, it is "sprung" to the desired size by setting off smaller charges in it

Then the charge (in this case a bundle of dynamite sticks) is lowered into the hole, the primer is placed, and earth is tamped lightly around the fuse

High Explosives Are the Weapons of U. S. Army's Demolition Men

retreat. The competent destruction of the oil wells and refineries of Tarakan and Balik-Papan, and the failure of such destruction at the bases of Penang and Singapore, will have deep and long-range effects on our fight in the Pacific. The progress of enemy tanks has often been held up by the blowing of wide, deep, steep-sided craters in the narrow roadways of hill country.

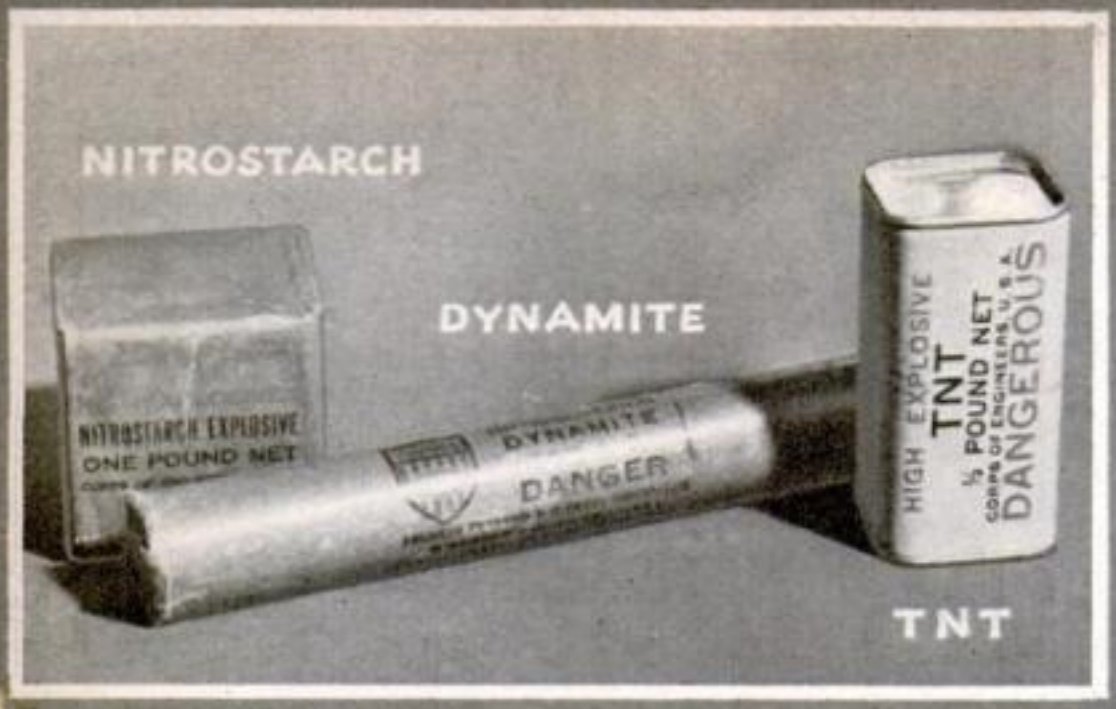
But demolition is an even greater offensive weapon. When parachute troops drop behind the enemy lines, their mission may be

Boom! Dirt flies sky-high, leaving a gaping crater to trap enemy tanks or put a block in a road at an inconvenient point

Electric current to set off the charge is generated by a small portable magneto. It is operated by giving the handle a twist of the hand

Firing wire is unwound from a steel reel and attached to the cap, while the inner end of the wire on the reel is connected to the exploder seen at right

to capture an airport. But they may be used just as well for breaking up enemy communications, wrecking bridges and railroads, preventing the advance of reinforcements. Such also is the work of the black-uniformed, cork-faced British commandos who slip ashore on the coast of occupied France to blow up ammunition dumps and otherwise harry



TNT is the standard explosive for general military use in forward areas. Insensitive, it is safe to handle and requires use of a high-explosive detonator

NITROSTARCH is similar to TNT and can be substituted for it in most uses. Set off by a commercial blasting cap. Will not freeze, but must be kept dry

DYNAMITE. Sensitive and dangerous to handle. Various strengths adapted for tree blasting, crater work, and mud-capping of masonry. Used in training

This is one way of attaching a fuse to a stick of dynamite

With a punch on one handle of the cap crimper, a hole is punched in the side of the dynamite cartridge about 1 ½ inches from the end, deep enough to receive all the cap and nearly parallel to the side of the cartridge

. . . then the cap, with fuse attached, is slipped into the hole. A piece of cord tied firmly around the fuse and then around the cartridge prevents it from pulling out

The charge may be set off either electrically or by fuse

An electric cap, taped tightly to detonating cord as at left, sets off the blast by remote control

Manually operated fuse lighter seen at right is yanked like a party popper to start fuse

To blow down a big tree in a hurry, an engineer places bunches of dynamite sticks around the trunk. Detonating cord, shown in hand at right contrasted with fuse, carries an explosion 19,700 feet a second and is used to assure a simultaneous blast

. . . in the various bunches of sticks that form the "necklace." Only one of the sticks has a fuse, the others being set off instantaneously by the violent explosion of the cord itself

the Nazis and obstruct their operations.

The apparent miracle of the German advance in 1940 against supposedly impregnable fortifications was largely the work of men with bundles of explosive, who stormed the pillboxes to lay their charges. They were organized in combat teams of squads and platoons, each rehearsed for a specific task. Practically every pillbox has its blind side, supposedly protected by guns of another pillbox. While the protectors were screened by smoke bombs, the demolition man would slip up to the pillbox on its blind side and place his explosive. Often this sort of job is done with a satchel charge, a bundle of explosive suspended from a string, hung on the end of a stick. With this simple equipment the attacker could whip his explosive around the side, or over the top of the pillbox, and set it off at the most vulnerable spot while remaining protected.

The war of movement has opened the field for the guerilla, commando type of tactics. Tanks on the march may be well-nigh irresistible, but in bivouac they are vulnerable to bush-fighters who creep up and attack with bombs in the dark. What the American Army is developing in the way of assault troops and assault tactics is something the enemy may be expected to find out for himself, preferably by surprise. But when the time for the attack comes, don't forget the boys with the satchels.

Down at Fort Belvoir, Va., little more than a stone's throw from Mount Vernon, are the Engineer School and Replacement Center, where thousands of new soldiers are learning the art of dynamiting. In their training they actually use dynamite, and also nitrostarch, so as to save the more scarce TNT for actual warfare.

TNT (trinitrotoluene) is the standard explosive for the U. S. Army in the field. It is a light-yellow crystal, one ingredient of which is toluene, a liquid now made as a by-product in the refining of kerosene, though some comes from the manufacture of illuminating gas. It is put up in half-pound blocks, 1¾ inches square by 3¼

A smaller tree may be blasted off by boring a hole in the trunk to receive the explosive charge. The amount of the explosive used is determined by the trunk diameter

Hole is filled with broken TNT with a primer block. Clay tamping plugs the hole and a fuse cap is inserted

. . . and this is the result. Trees can be felled in large numbers in this way for use in blocking roads, making tank traps, and other purposes that call for quick action

inches long, in cardboard cartons with tin ends. There is a hole in the end of the block for introduction of the cap. If the hole is not large enough for the detonating agent at hand, the explosive man has a drill like an auger to dig out a larger hole.

One of TNT's great values is that it is insensitive. It can be kicked around roughly without detonating, and small quantities of it can be burned without explosion. A high-explosive detonator is needed to set it off. This is usually a cap made of tetryl, and the tetryl in turn is exploded by a small quantity of fulminate of mercury mixed with potassium chlorate. This mixture is very sensitive and can be set off either by electricity or by a burning fuse.

Ordinarily charges are set off by electrical wiring and a small magneto known as a blasting machine. But for quick jobs, especially when it is desired to set off a number of charges simultaneously, the Army uses detonating cord, commercially known as primacord. This is a flexible, waterproof fabric tube, about 1/5 inch in diameter (yellow with a rough surface for easy identification) which is filled with a high-explosive core—a white crystalline substance known as pentaerythritetetranitrate. An explosion travels along this cord at the rate of 19,700 feet a second, and it is a violent explosion sufficient to set off any TNT in contact with it. It is especially useful in obtaining the simultaneous explosion of a whole mine field.

The detonating cord is also useful in making the implement of assault known as a bangalore torpedo, developed in the first World War for cutting barbed wire. Blocks of TNT with holes bored in them are strung

WORKING ON THE RAILROAD. Destruction of track is part of the dynamiter's job. Here a block of TNT is wired to a rail and sandbagged . . . with the result shown here. Demolition men are taught to find the spots in bridges, tunnels, and switches where a blast will do the most harm

BANGALORE TORPEDO clears a path for infantry through barbed wire. It is made by stringing blocks of TNT on detonating cord to make a 20-foot necklace as shown at the left. This is wrapped on a stick and inserted in a piece of iron pipe. When slipped under a wire entanglement and exploded by a fuse, it throws steel fragments that cut the wire

on the detonating cord like a necklace 20 feet long. This in turn is inserted in a long iron pipe.

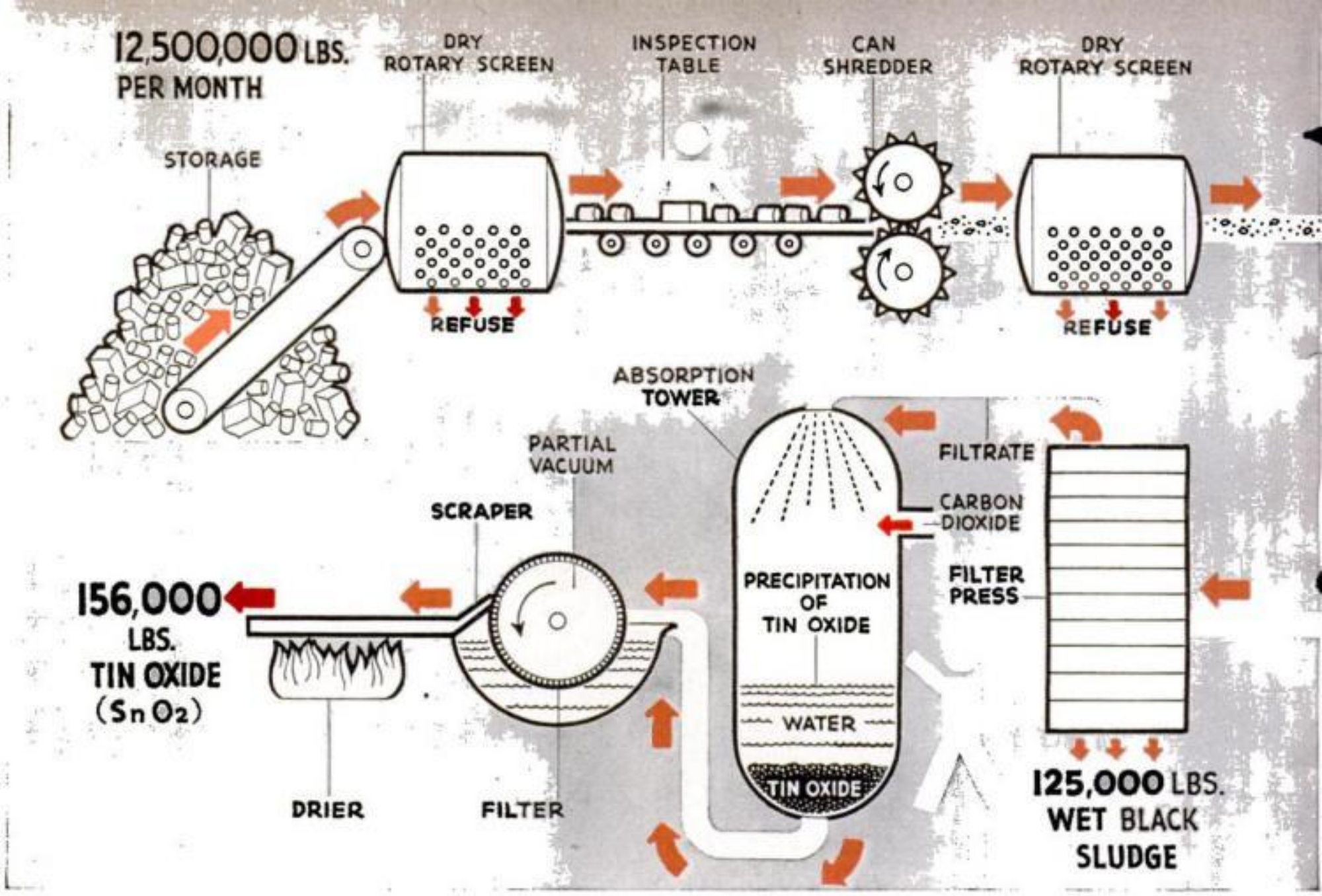
The bangalore torpedo is used to open up a gap in a barbed-wire entanglement so that troops may rush through. It is slipped under the wire, close to the pickets to which the wire is attached, and exploded by a fuse which gives the dynamiter a chance to get away to a shell hole or other shelter. In exploding, the fragments of pipe cut the wire like knives, and sweep the barbed-wire entanglement clean for 20 feet or more.

All kinds of mining comes into the work of the engineers, but this war has developed a new kind—the trap mine, or booby trap. The Axis started it, leaving all sorts of fiendish practical jokes behind them in territory from which they have retired. If you found a bright new fountain pen lying on the Libyan Desert, you wouldn't dare to pick it up. It probably would be attached to the trigger of a mine, which would blow you to bits.

The effectiveness of booby-trap mines against an army of occupation lies in their not conforming to any pattern. In their training lesson on booby traps, the soldiers have issued to them a motley collection of ordinary mouse traps, spring clothespins, flashlight batteries, nails, and rubber bands, together with a supply of low-power caps to set off firecrackers. From then on it is up to them to improvise strange Rube Goldberg inventions to entrap the enemy.

New explosive for bangalore torpedoes is Nitramon, which comes in sectional cartridges. A primer cylinder is fitted with a detonating cap as above . . .

. . . and this is screwed into the first Nitramon unit. Additional cartridges are added to make up the charge, which is inserted in the torpedo pipe



Flow chart showing what happens to tin cans in a typical plant which recovers both tin and steel

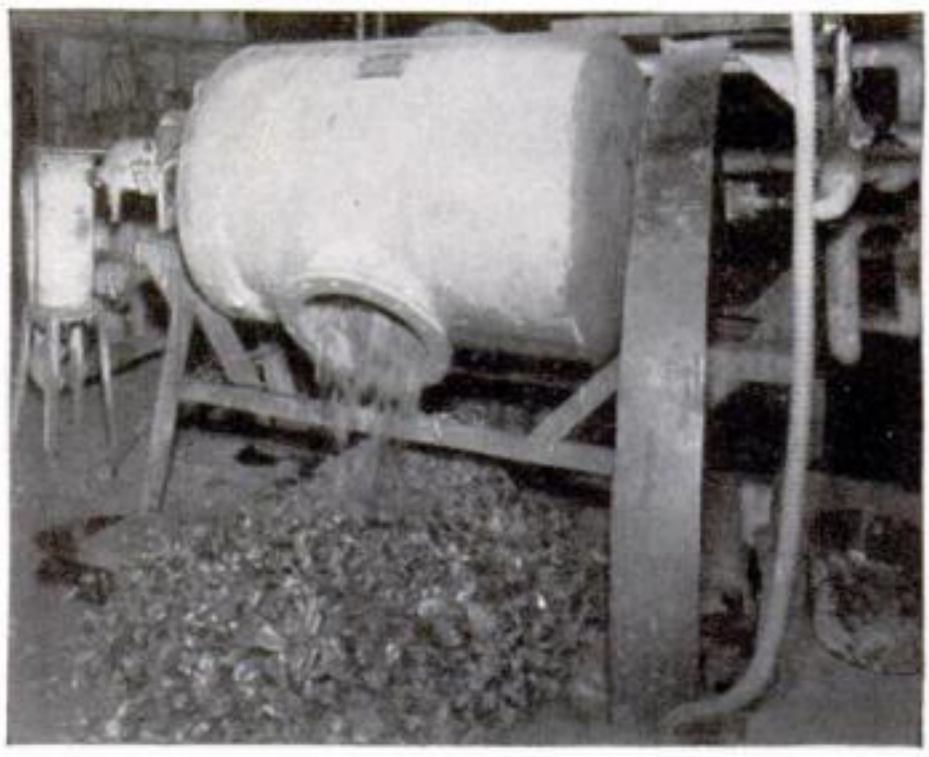
Tin From Old Tin Cans

CHEMISTRY MINES NATION'S DUMPS FOR VITAL WAR METAL

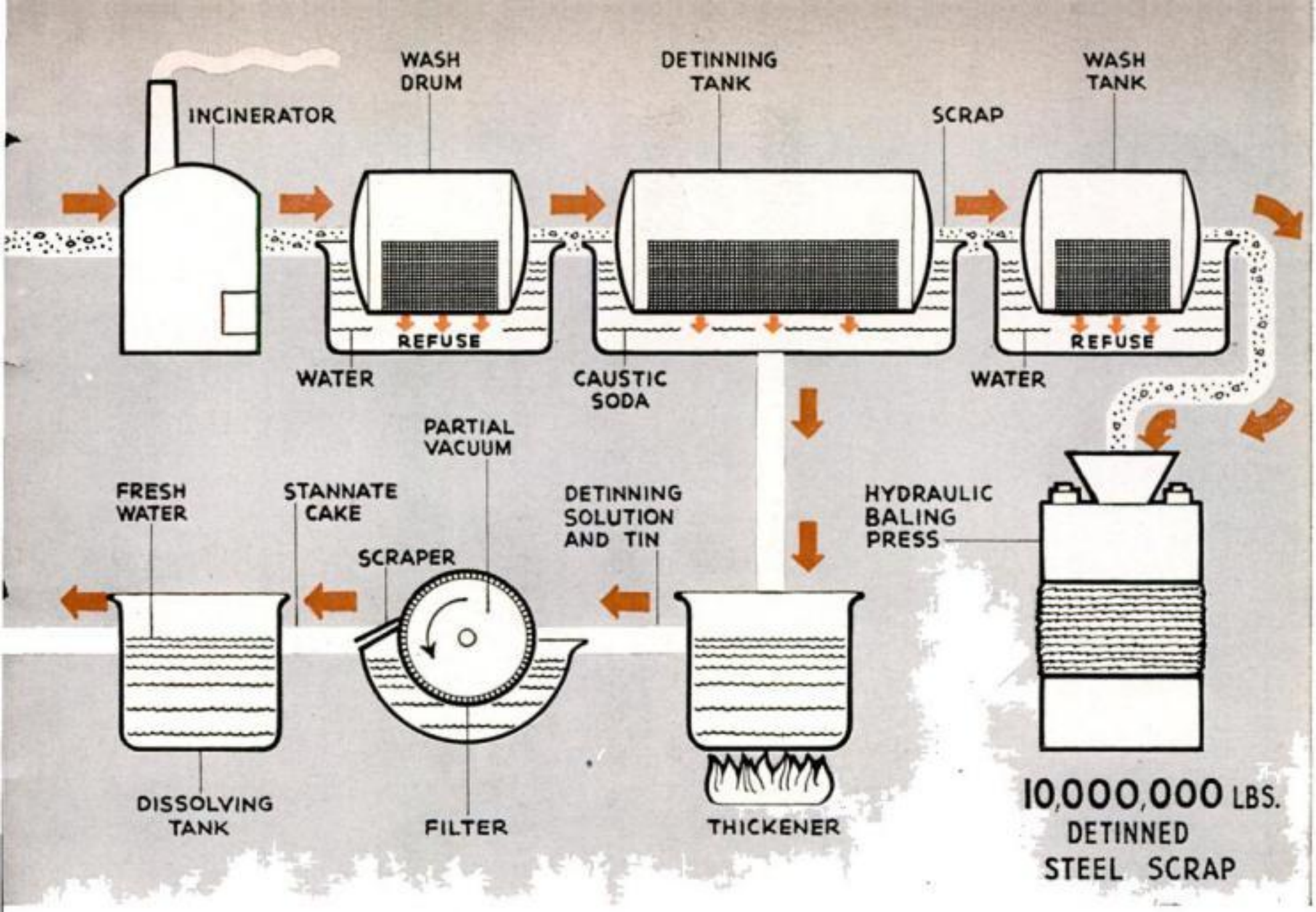
TIN cans, carefully collected in some parts of the United States, are rapidly finding their way into reclaiming plants where the tin coating and base metal are separated for future use in wartime production.

The process of detinning is simple, although practical only when other sources of the metal are cut off. Cans are placed in a rotary boiler with a screen bottom to shake out dirt. From this point they are fed into a shredder which cuts them into small pieces. These are placed in an incinerator heated to a temperature of 800 degrees, to burn off labels and other inflammable materials. After a thorough washing, the metal is immersed in a tank filled with a solution of caustic soda which dissolves the tin from the base metal. Pieces of steel, stripped of their tin coating, go into a baling press for use as scrap.

The caustic soda and tin solution is then thickened by heat, filtered to remove impurities, and passed into an absorption tower. When carbon dioxide is combined with the filtrate, tin oxide precipitates in the bottom of the tower. Finally the tin oxide is dried, formed into cakes, and



Scraps of steel from shredded cans being dumped from a digester tank in which the tin has been removed by treatment with a solution of caustic soda

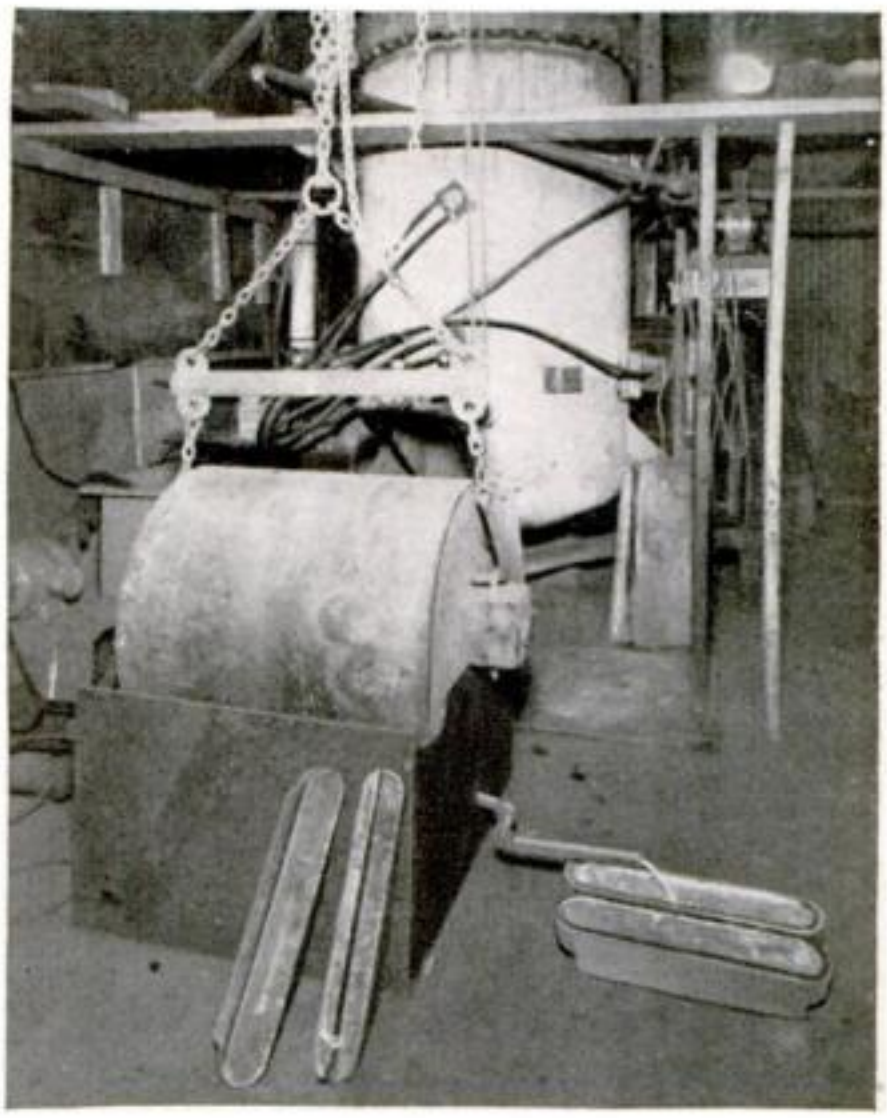


End products are baled steel scrap and tin oxide. The latter is readily convertible into pigs of tin

shipped to factories that are using the metal.

A detinning plant in San Francisco, operated by the Metal and Thermite Corporation, is capable of handling 12,500,000 pounds of tin cans per month. Out of this amount, 10,000,000 pounds of steel and 156,000 of tin oxide can be salvaged.

Since the detinning of cans is a new development produced by the war emergency, the processes used at the various plants differ considerably. No doubt, experience will disclose the methods that are most efficient and lead to the recovery of tin and iron with the maximum economy.



At left, a bale of steel scrap comes from the hydraulic press. This is a high-grade melting scrap that can be used again in the manufacture of new cans and other products. The tin that has been removed from the metal is seen above in the form of tin pigs, with an electric precipitation roller on which the tin was deposited by electrolysis

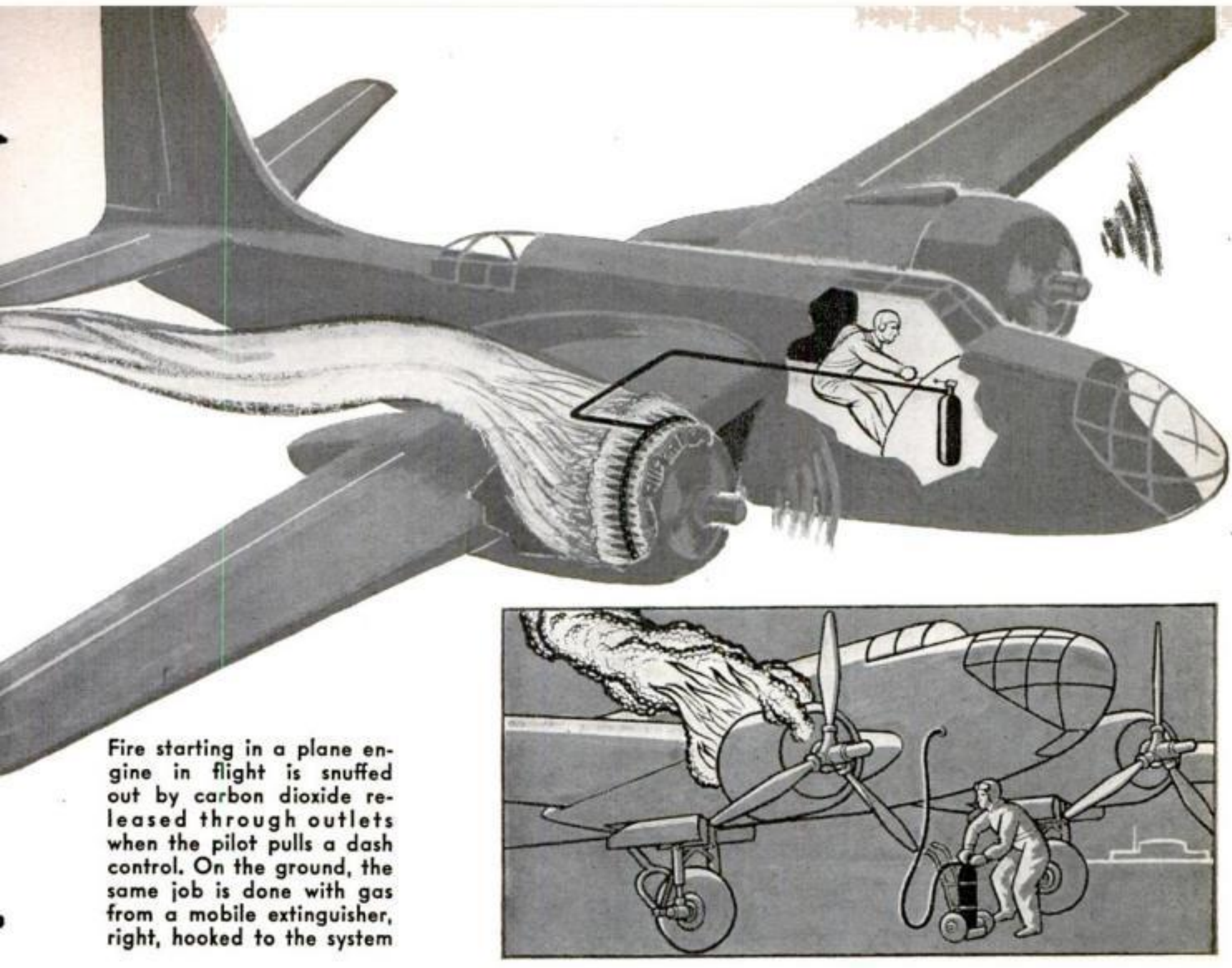
Army Wreckers Rescue Trucks

At left, a ravine is straddled by a couple of army wreckers, set to lift out an Army truck lying on the bottom. From each of the cranes, one towline and one guide line were sent down

Up she comes! Here's the truck in midair as the wreckers pull on their lines from both sides. Salvage looks easy this way

UNCLE SAM has made special provision for getting his Army trucks out of serious difficulty with a minimum of delay. When a convoy is moving over mountainous terrain, it sometimes happens that a truck tumbles into a canyon, and without special equipment it would just have to stay there. Each convoy, however, is supplied with a pair of special wrecking trucks—four-tonners—fitted with overhead cranes. The convoy commander calls them up, and one is parked on each side of the ravine into which the truck has fallen. From each a towline is run to the truck by way of a pulley attached to a tree, and a second line is connected directly to the truck. The pair running through pulleys lift the truck, and the free lines are used as guides. Major General Joseph W. Stilwell, in command of a Pacific Coast unit, recently inspected a pair of the new wreckers, and found them effective in saving labor and valuable time.

Diagrammatic view of the whole process, with the well-anchored wrecking units hooked to the fallen truck



Fire starting in a plane engine in flight is snuffed out by carbon dioxide released through outlets when the pilot pulls a dash control. On the ground, the same job is done with gas from a mobile extinguisher, right, hooked to the system

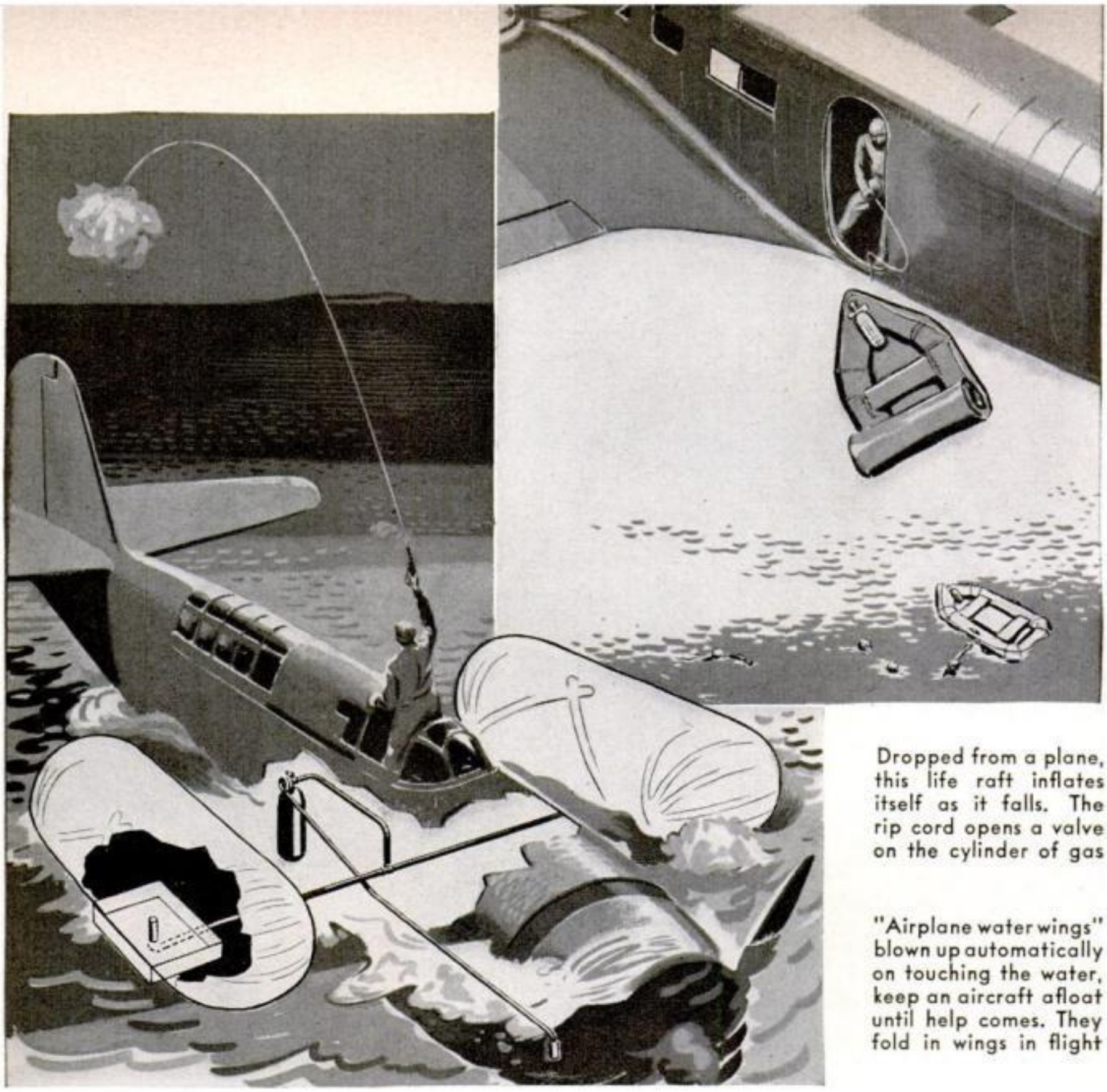
A War Gas That Saves Lives

Carbon Dioxide—the Stuff That Fizzes in a Soda—Guards Fighters Against Perils of Fire and Water

WHEN the pilot of a military airplane goes aloft, his safety depends primarily upon his skill as a flyer, the speed and maneuverability of his ship, and the fire power and accuracy of his guns. But if these fail, if his engine catches fire or he has to bail out over water, he may owe his life to one of the most commonplace of substances—carbon dioxide, our old friend CO_2, which permits a permanent wave to be set without congealing it in gum, and puts the sparkle in your beer and the fizz in your ice-cream soda.

As every schoolboy knows, CO_2 is a colorless, odorless gas, 1½ times heavier than air, its molecule composed of one atom of carbon and two of oxygen. It can be used as a gas and as a solid, but not as a liquid, although in order to be used at all it must start as a liquid. It expands with extraordinary rapidity and force, a property which is just beginning to be employed for inflation and as a source of power. One pound of liquid carbon dioxide will expand almost instantly to 450 times its volume, releasing 30,000 foot pounds of energy.

Nature produces CO_2, but this source of supply cannot be depended upon. About one fourth of the 300,000,000 pounds used annually in the United States is manufactured as a by-product by breweries, distilleries, and lime kilns. The remainder is obtained by burning coke, high-grade coal, and natural gas. The gas going up the flue towers from these fires is about 20 percent carbon dioxide, which is washed, picked up by a



Dropped from a plane, this life raft inflates itself as it falls. The rip cord opens a valve on the cylinder of gas

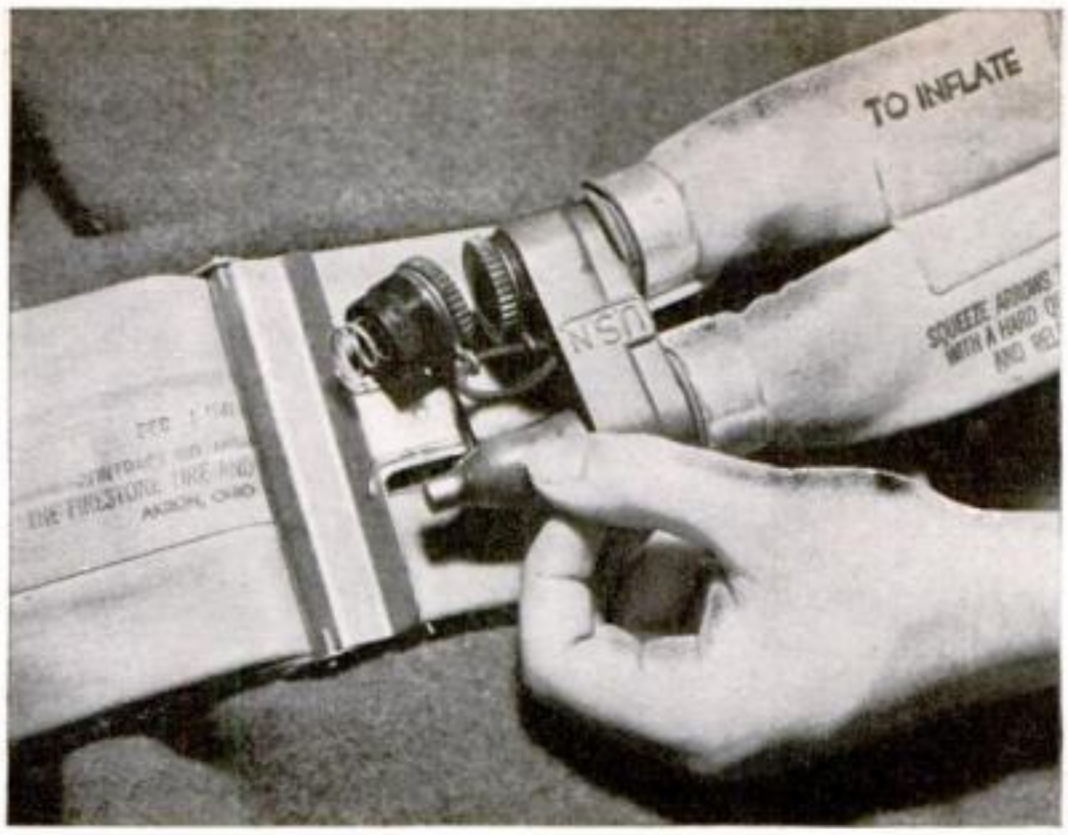
"Airplane water wings" blown up automatically on touching the water, keep an aircraft afloat until help comes. They fold in wings in flight

sodium carbonate solution, boiled out of that, compressed into liquid form, and sold for commercial purposes in 20 and 50-pound steel cylinders.

In modern warfare, carbon dioxide is a gas of increasing importance, but it saves lives instead of taking them. If a plane is disabled and must make a forced landing on the water, CO_2 gives the pilot and his crew better than a fighting chance. Each man, as he bails out, wears under his parachute harness a rubberized inflatable jacket, under the front of which are two cartridges of carbon dioxide about the size of a cigar. He pulls the ripcord which opens his parachute, and a moment later sticks his thumbs through two rings which hang from the CO_2 cartridges. A yank opens the valves, carbon dioxide pours into the jacket, and almost instantly it is inflated to sustain a 200-pound man.

Meanwhile, the pilot above—or perhaps a rescue plane—has thrown overboard a small bundle which severs its own ripcord as it plunges downward. This action also opens the valve of a cylinder of carbon dioxide about as large as a milk bottle, and by the time the bundle hits the water it has become an inflated life raft or dinghy. Stocked with water and food concentrates, it will keep its crew afloat for several days—the record to date is 8½. The British have saved more than 300 men with these boats. Standard equipment in the R.A.F. is a round dinghy, while most American combat planes carry oval-shaped rafts, which are supplied with oars. Another type, called the "pop-out," is automatically inflated with carbon dioxide as soon as the airplane lands on the water, and the crew members simply step aboard when ready to abandon ship.

Frequently the plane itself is saved through the use of carbon dioxide. Compartments containing two large deflated rubberized bags, and fitted with pop-out doors, are built into the wings of planes which fly over water. The bags are connected with tubing to a cylinder of carbon dioxide, the valves of which are opened by water-sensitive switches as soon as they are



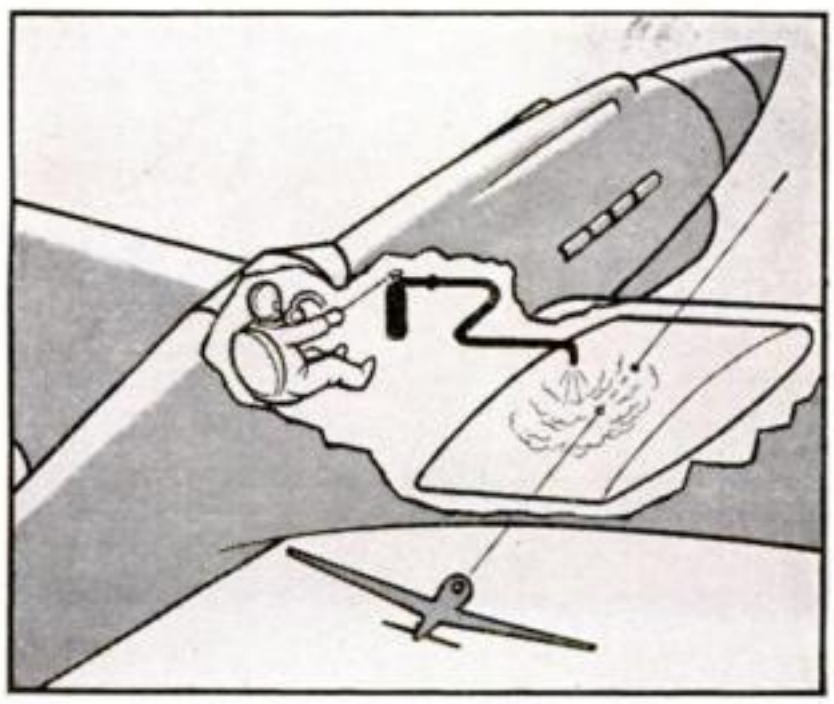
Navy men on surface craft wear lightweight lifebelts like this. Tiny cylinders quickly fill it with gas sufficient to support a man in the water

submerged. The gas immediately inflates the bags, which pop from their compartments and keep the plane afloat until the arrival of rescuers. Many American bombers ferried across the ocean have been equipped with flotation bags, but best results are obtained when the bags and pop-out compartments form an integral unit of the ship.

The modern airplane engine, hot and oily, may burst into flame at any moment from a stray spark. Formerly, that spelled disaster; today, split-second detection devices release a cylinder of carbon dioxide into a perforated pipe encircling the rear accessory compartment, where the fuel lines come in. It simply erases the fire, despite the blast of air entering the cowl, before the pilot has had time to start worrying about it, and so quickly that the engine is undamaged. Warm-up fires which sometimes occur in carburetors and

A naval pilot bailing out at sea first opens his parachute, then yanks two cords at his waist. Carbon dioxide from cylinders inflates his life vest

Explosionproof fuel tank. Entering combat, pilot feeds carbon dioxide into air space above gasoline so incendiary bullets can't ignite fumes

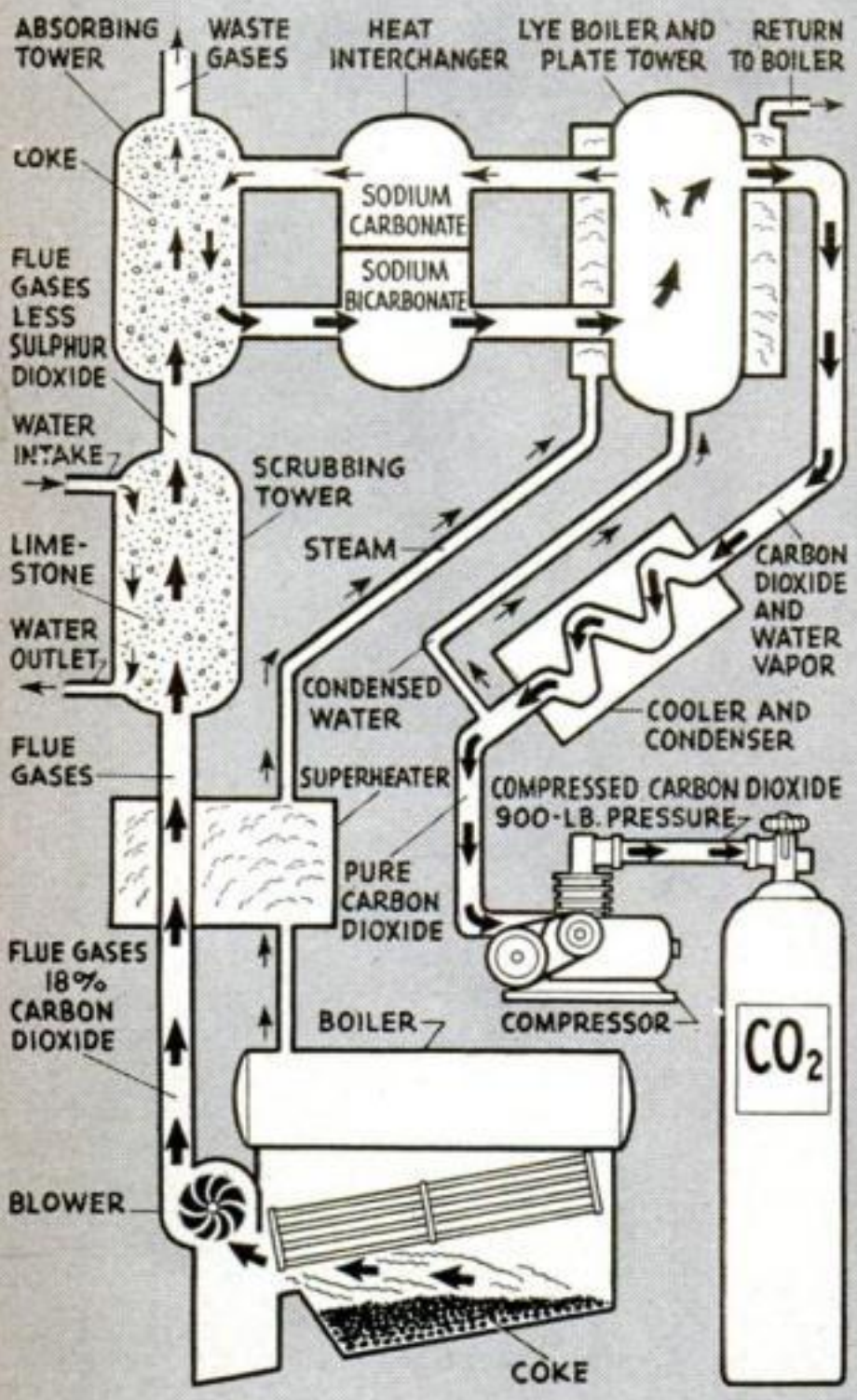


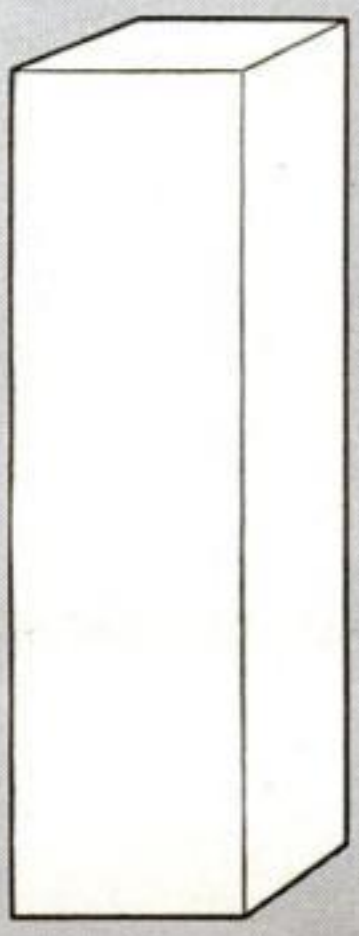
Our Cover

FAST WORK by the crash-truck crew of a military airport is the subject of this month's cover painting by Anton Kurka. Designed for rescuing flyers from planes that catch fire in taking off or landing, the truck carries banked cylinders of carbon dioxide for smothering the flames. Trained crewmen wearing weird asbestos suits spray the snowlike stream from long hose nozzles. Rescue tools and a crane are included in the equipment.

HOW CO_2 IS MADE

Flow chart shows how carbon dioxide is extracted from flue gases from burning coke. Carbon dioxide forced into container at end of process is in liquid form





ONE POUND OF CO_2 LIQUID WHEN FREED FROM TANK EXPANDS TO 450 TIMES ITS VOLUME

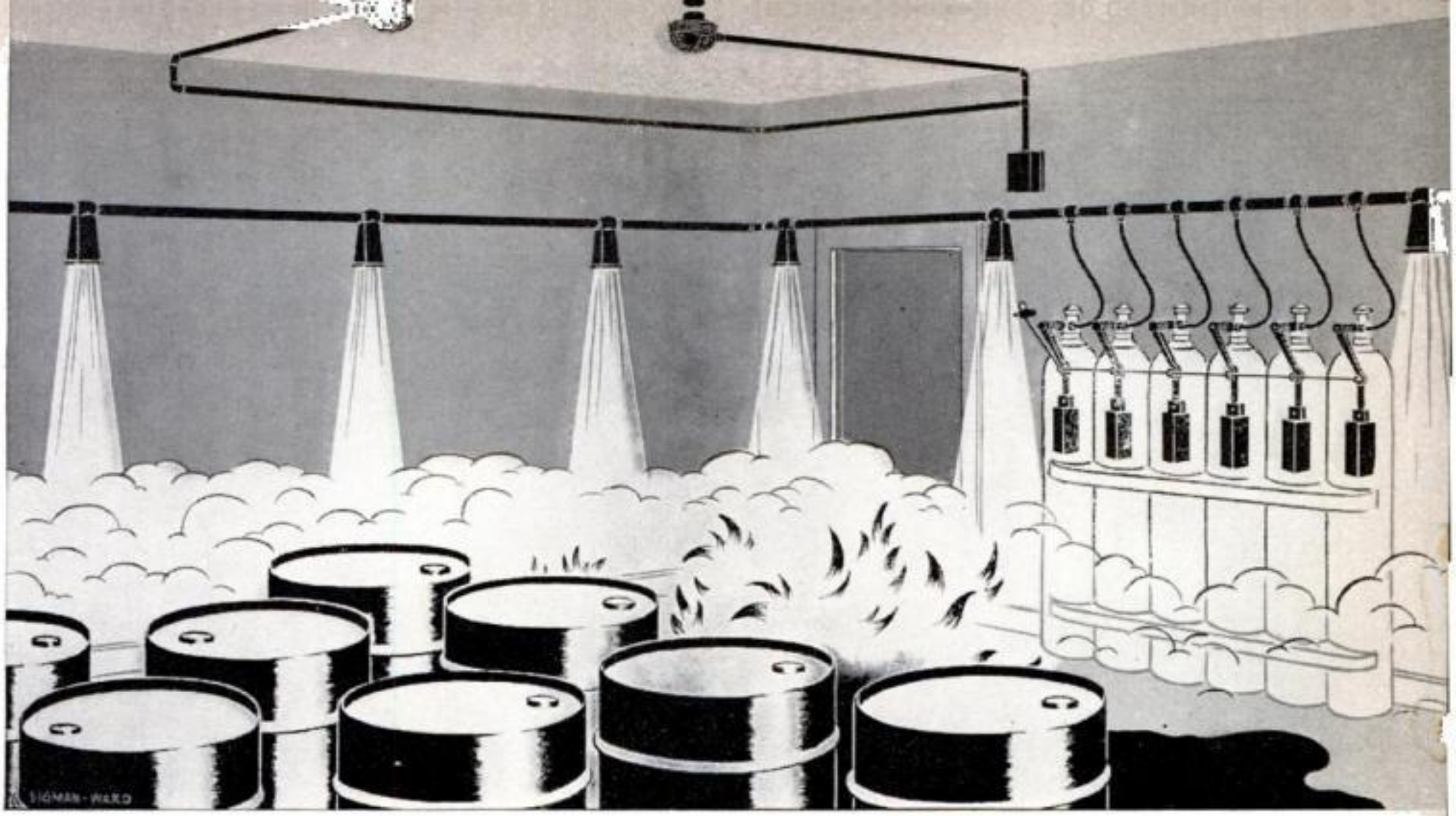
engine compartments are snuffed out with carbon dioxide from a portable extinguisher plugged into a connection on the fuselage by the mechanic who is servicing the plane. It floods the burning engine compartment with gas through the ship's piping system.

Carbon dioxide again comes to the rescue when the gas tank of a fighting airplane is pierced by a flaming tracer or incendiary bullet. Self-sealing tanks are now standard equipment on all combat planes, so that there is no leakage of fuel. And no fire or explosion occurs because when a plane goes into action the pilot pulls a dash control which starts carbon dioxide feeding into the space above the gasoline.

The horrors of a crash fire have also been eliminated by carbon dioxide wherever proper equipment is available. If something serious goes wrong when a plane takes off or lands on or near an airport, out comes the crash truck—the last word in our present knowledge of how to conquer the particularly formidable type of fire that may follow a forced landing and imprison the plane's personnel. It carries, along with other equipment, ten 100-pound cylinders of carbon dioxide arranged in batteries of five. Each battery is connected to a hose reel of 200 feet of one-inch high-pressure hose with a special shielded nozzle, with which the rescue crew envelops the burning plane in clouds of smothering gas. Hitherto it has been impossible to concentrate enough carbon dioxide to have much effect on big hangar fires, but a patent has just been issued on a device which the inventor, Eric Geertz of Glen Ellyn, Ill., believes will conquer these difficulties. Geertz proposes to use containers about the size of railroad tank cars, filled with liquid carbon dioxide under pressure and located between the hangars. They would be fitted with pipes leading to outlets in the buildings, and the valves could be opened by fire-detection apparatus or manipulated by hand.

Fires of wood or other carbonaceous material are characterized by glowing embers, and are best cooled and quenched by water. For fires of inflammable liquids or in electrical equipment, water is perhaps the worst thing to use, as it will simply spread the flame. These fires have to be smothered, and in the electrical blaze a nonconductor is essential.

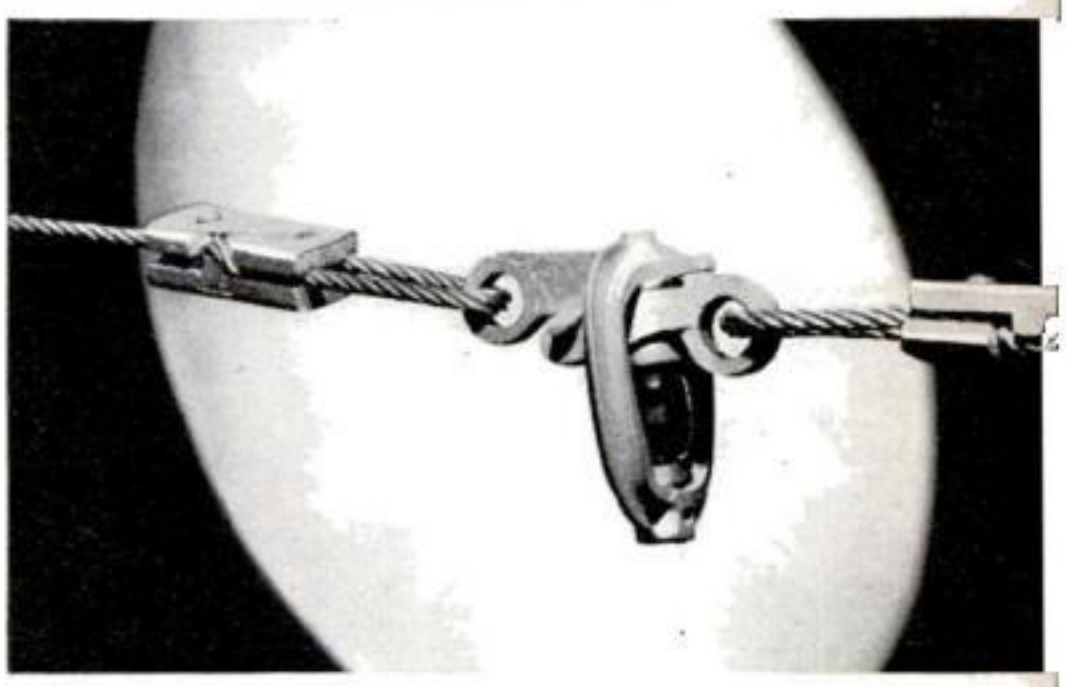
The inflammable-liquid fire is today the worst of the hazards that threaten not only the airplane but most processing industries. One of the most astonishing demonstrations of carbon dioxide's power to extinguish such conflagrations is seen when a vat of some warm inflammable liquid suddenly reaches the flash point and bursts into flame over the whole surface. The protection against



For extinguishing fires in inflammable liquid, a fire-detecting device (on ceiling, above) allows weights to drop, releasing gas into nozzle system

such disaster consists of a line of perforated pipe under the surface of the liquid and encircling it. Sensitive fire-detection apparatus releases the pent-up CO_2 which instantly rises through the liquid and literally lifts the fire from the surface into nothingness by displacing a volume of air sufficient to lower the oxygen content.

Three principal types of fire-detection apparatus are in common use for tripping carbon dioxide valves. One is the fusible link, merely a weak spot in a tension line, made of a metal alloy which melts at a pre-determined temperature and releases a valve mechanism. Another is the quartz-bulb device. This is completely filled with a certain liquid having a high coefficient of expansion, which has been heated to, say, 130 degrees Fahrenheit and the bulb sealed. When normally cool, the liquid contracts, leaving a part of the bulb filled with vapor. Expanding with the heat of a near-by fire, the liquid again reaches the limits of its prison and, still expanding, bursts the quartz and releases the linked ends of a cable. The device is set for any temperature desired, within limits, merely by filling the bulb with liquid heated to that precise temperature. A third type of detector works on the basis of the rate of temperature rise. Temperatures of the air about an airplane may be high, or they may be low. It is when the temperature suddenly jumps up that the fire danger is recognized by this pneumatic-thermostatic detector. All three of these types act independently of any electrical system; they depend upon nothing but their own powers.



Another detector is the quartz bulb which bursts at a fixed temperature, breaking a cable coupling. Weights below then drop, opening cylinder valves

Fur-lined suits for Army flyers, stored at the air depot at Fairfield, Ohio, are kept free of moths by "intermittent refrigeration." For a few days each month, temperature in the storage room is put through a cycle between 18 and 70 degrees F. This teasing finishes the moths with maximum economy

THE AERO STOREKEEPER, WITH HIS 108,000 ITEMS — —

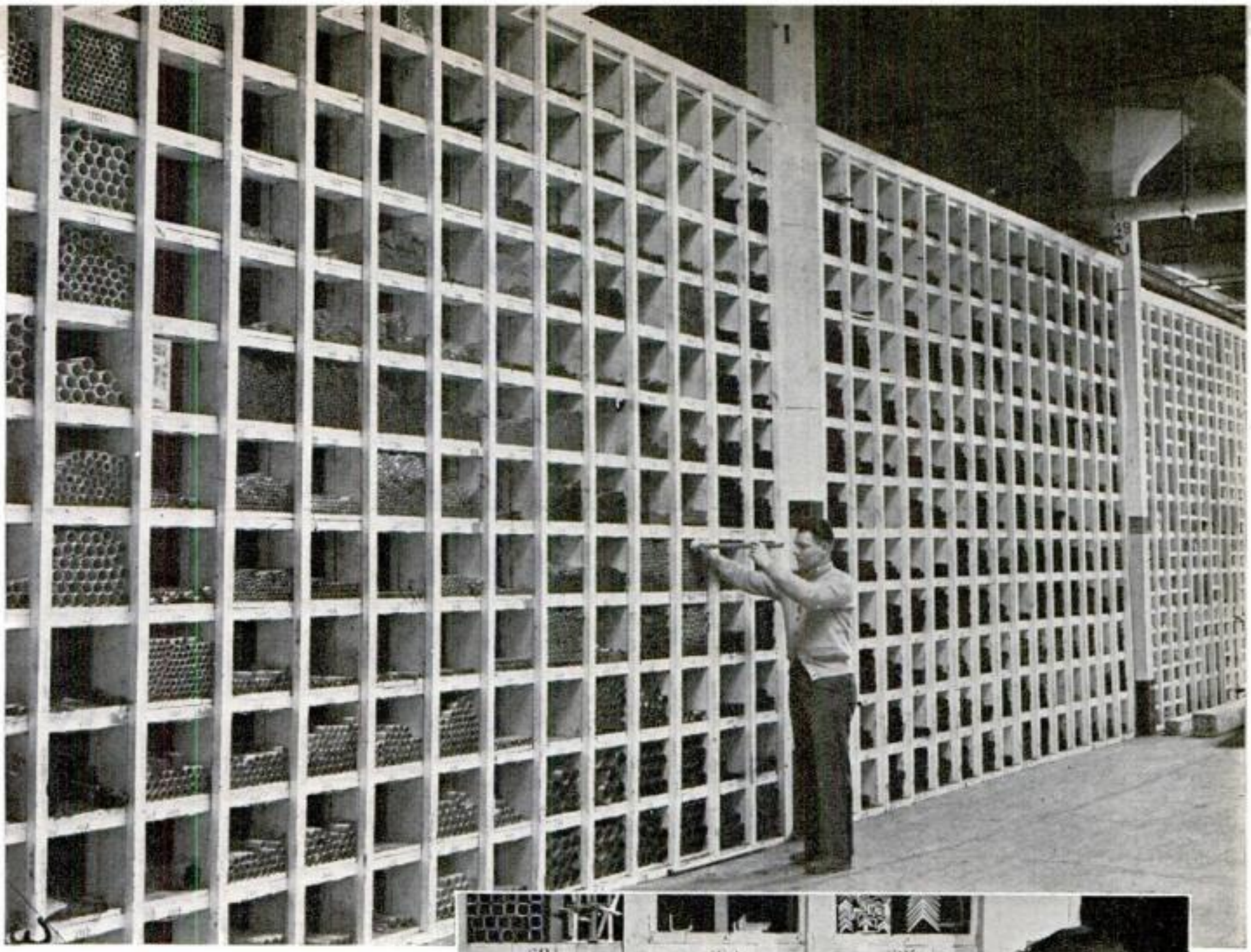
Keeps 'Em Flying

THE Army needs a new propeller blade at Mobile, Ala. A teletype order flashes over the wires to its air depot at Patterson Field, Fairfield, Ohio. Within three and a half hours, a fast plane bearing the blade glides to a landing, and mechanics are installing it in place of a damaged one.

Centrally located to serve states east and west of the Mississippi River, Patterson Field's air depot (Army men pronounce it "deppo") is typical of others. Its Supply Section and its Engineering Section constitute two of its major activities.

Resembling nothing more closely than a gigantic hardware store, the Supply Section houses no less than 108,000 different kinds of parts and fittings, in nearly as many compartments and shelves. These are the items drawn on by other fields for replacement. They include airplane wings, engines, propellers, and tires; tubing of aluminum alloys and other materials; round and square steel bars; extruded shapes of all descriptions; and flying suits, to mention only a few of the articles. How to store thousands of them, so that any one could be located in a hurry, was a problem solved by Homer L. Morgan, head property and supply officer. A system of colored code letters and numbers now identifies each corridor, aisle, and compartment in a master plan.

Specially interesting items carried in stock are a compact mooring kit that enables a pilot to secure his plane to the ground temporarily, and an emergency jungle kit that provides for the needs of a



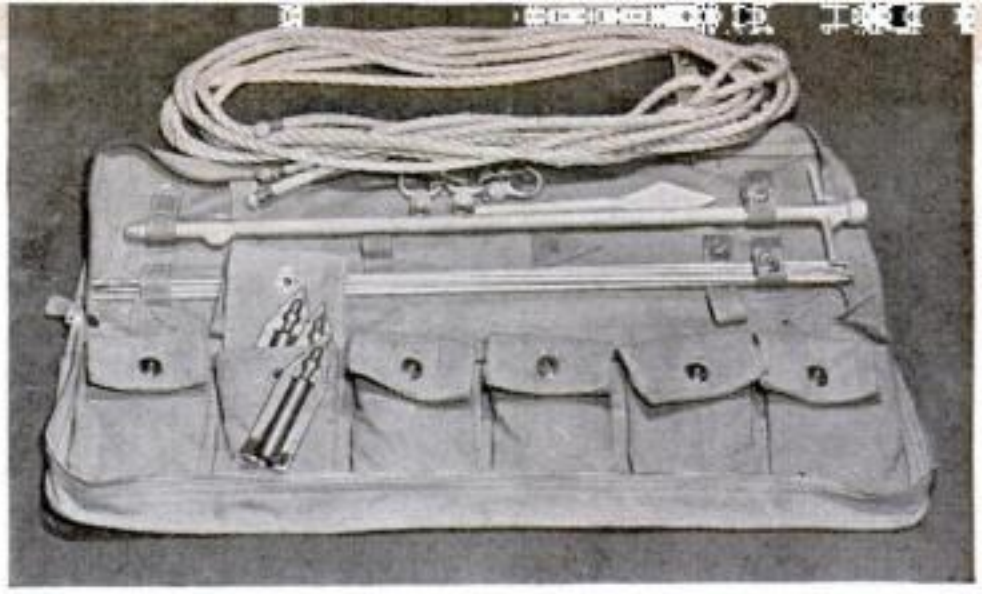
Indexed compartments like these hold 108,000 different kinds of spare parts, to be drawn upon by other fields for replacement use. This is the tubing section

Extruded shapes of all kinds are kept in stock. To make it possible to locate any of the thousands of items in a hurry, a system of code letters and numbers is employed

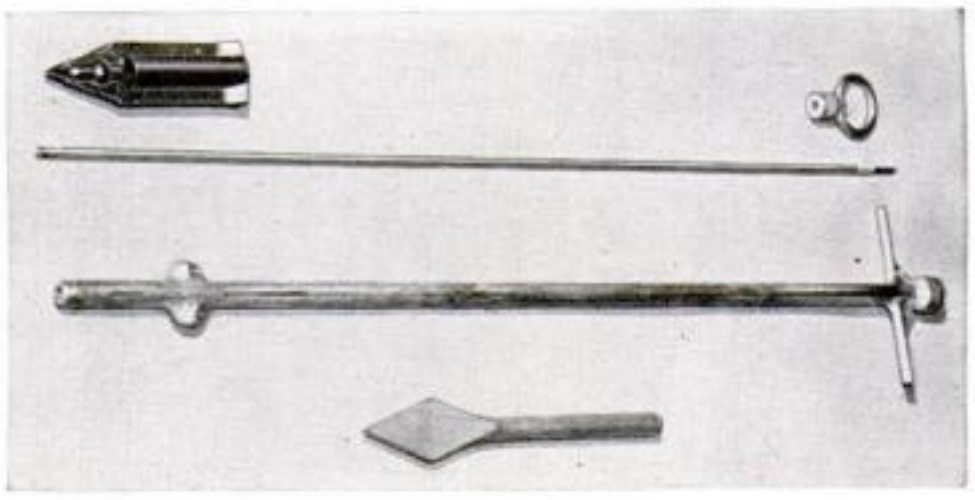
flyer forced down in a tropical wilderness. The mooring kit includes barbed anchor rods, tools for driving them even into frozen ground, and rope for attaching to rings in the wing tips of the plane.

Packed in a carrying case that can be slung over a shoulder, the jungle kit contains a machete with which a grounded flyer can hack a path through tangled undergrowth, and a pocket compass to guide him on his trackless route to a friendly outpost. Emergency rations, consisting of eight ounces of hard bread and six ounces of chocolate, will suffice him for a week or more. He may supplement his diet by means of fishhooks and line. He lights his campfire with matches from a waterproof case, and similar containers hold iodine for purifying water and treating cuts and scratches, and quinine to ward off malaria. Also included in the outfit are a generous piece of mosquito netting and a small can of oil for the user's gun.

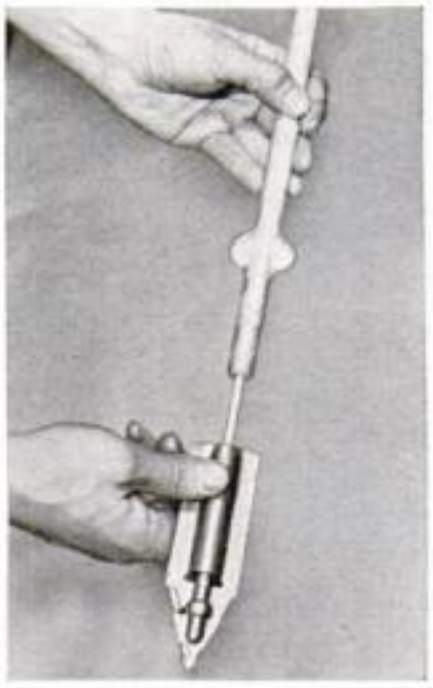
Civilians might profit from the depot's method of keeping fur-lined flying suits free of moths. "Intermittent refrigeration" does the trick. For the first two days of each month, the refrigerated storage room is kept at 18 degrees F. On the third day, the temperature is allowed to rise to 70 degrees. Dormant moths that survived the first cold now show signs of life, but their activity is shortlived. Back to 18 degrees goes the temperature for the fourth and fifth days, and that is the end of the moths. For the remainder of the month the temperature is

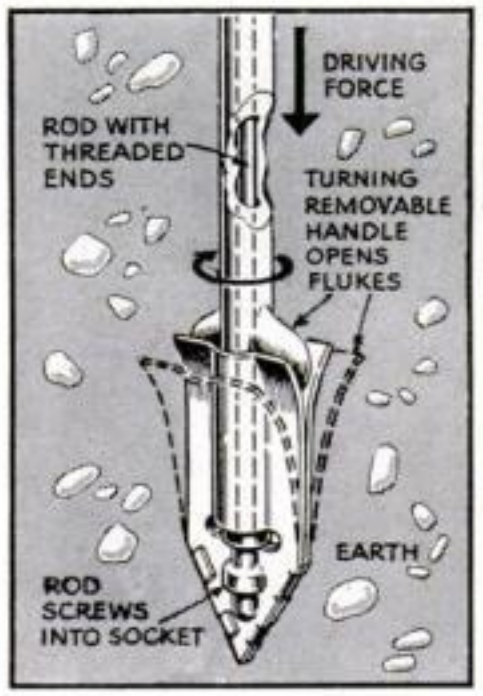


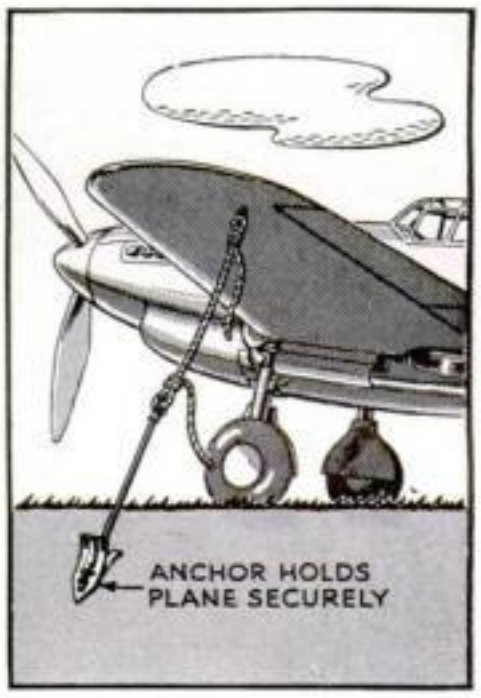
This compact kit, seen folded at left, enables a flyer to moor his plane. Below are the parts of one of the anchor rods, with the tools used in planting it

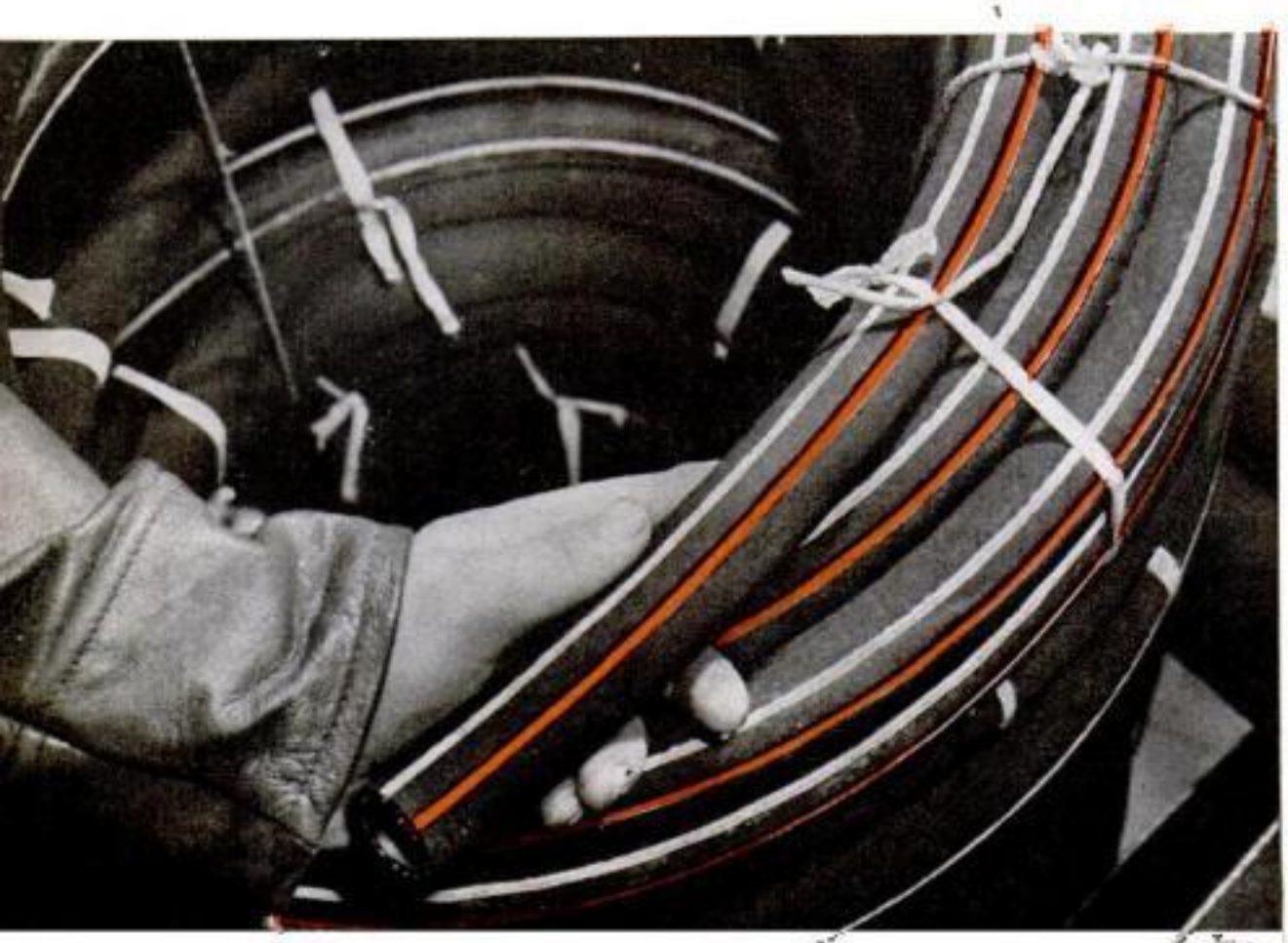


How the mooring kit is used: First the rod is screwed into the metal barb and a hollow tool is slipped over it to help force it into the ground. A quarter turn of the tool spreads the flukes to provide an anchor. The ringed cap is screwed to the end of the rod and joined by a rope to an eyelet in a wing tip of the plane. A diamond-shape tool breaks frozen soil









An elaborate color-marking system helps identify the various kinds of items in stock. The hose at left, for example, has a white and a red stripe to show that it can be used for either oil or water. Hose with only a white stripe has not been made resistant to oil and therefore is usable for water only. A master plan shows meanings of colors and symbols

kept at 40 degrees, and then the cycle begins again. According to the Air Corps, the system combines effectiveness with economy.

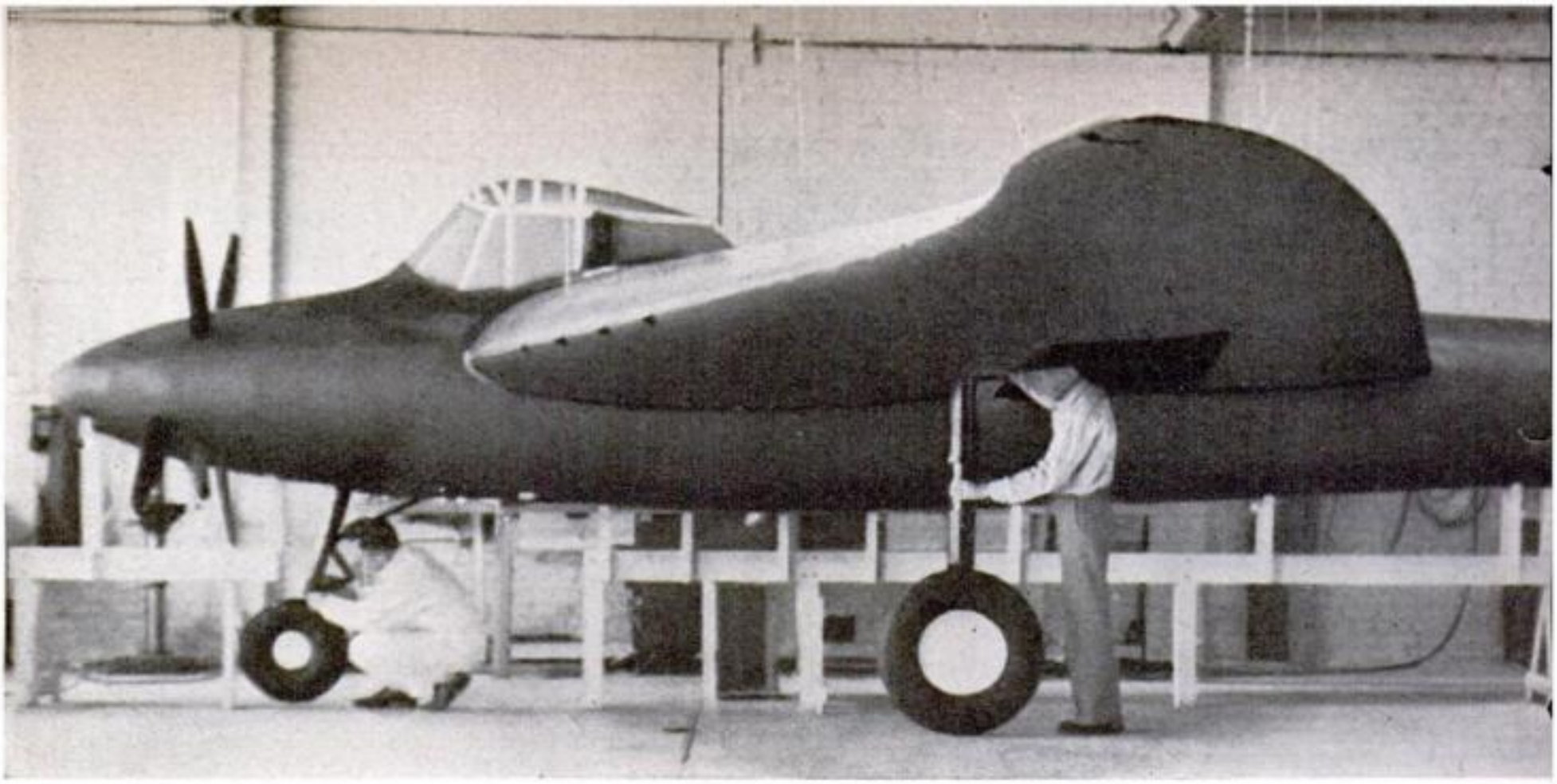
To the Engineering Section of the depot comes the endless variety of flying equipment brought in for repair, from oil pumps to more or less whole airplanes. Mechanics install new parts as needed; damaged ones are examined for possible salvage. After its allotted number of overhauls, an airplane engine may be fit to fly no more—but it still may be good enough to serve for instruction in a military or civilian air school.

Markers of various hues identify classes of material entering and leaving the depot. New equipment arrives with blue tags, affixed by Air Corps inspectors at the place of manufacture. Green tags denote parts that are repairable. When they are repaired, inspected, and passed, they receive yellow tags. Red tags indicate material found no longer airworthy.

By the development of this uniform marking system and its adoption throughout the Air Corps, it is hoped that the handling of all materials and supplies will be simplified and the possibility of mistakes will be reduced, thus adding to safety.

Spare wings for many types of planes are available for replacement. Stored as pictured above, they can be crated quickly for shipment to any field where they are needed. Engines, tires, and propellers can be sent out on short order. Whether it's a giant landing-gear tire for a B-17 Flying Fortress or a propeller for a P-40 fighter plane, the Fairfield depot is never caught short

Any Army flyer who is forced to land in a tropical wilderness will find this "emergency jungle kit" mighty handy. Carried in a shoulder pouch as seen at the left, it contains a sharp machete, pocket compass, emergency ration for a week, fishhooks and line, mosquito netting, matches, medicines, gun oil

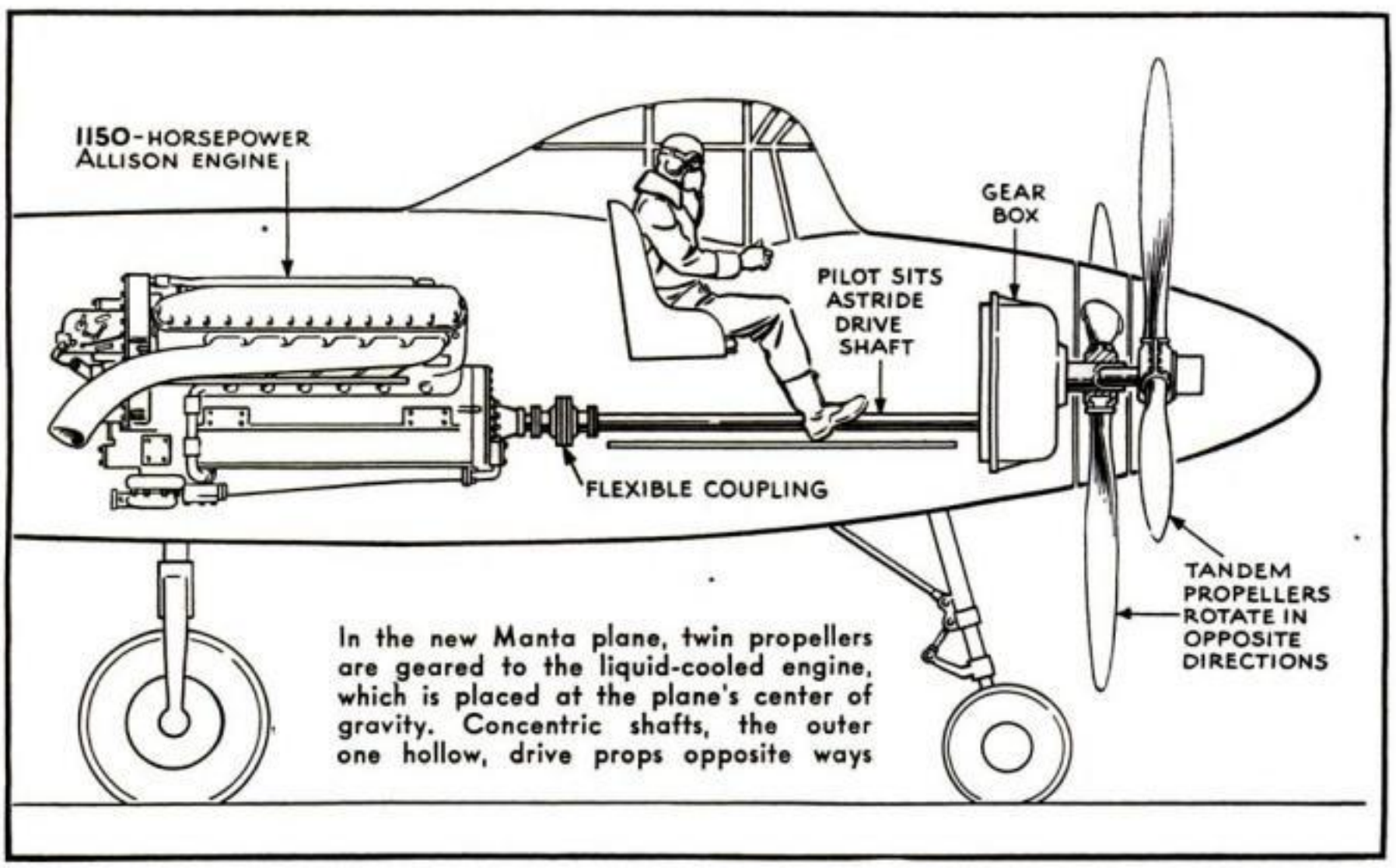


MANTA Fighter Has

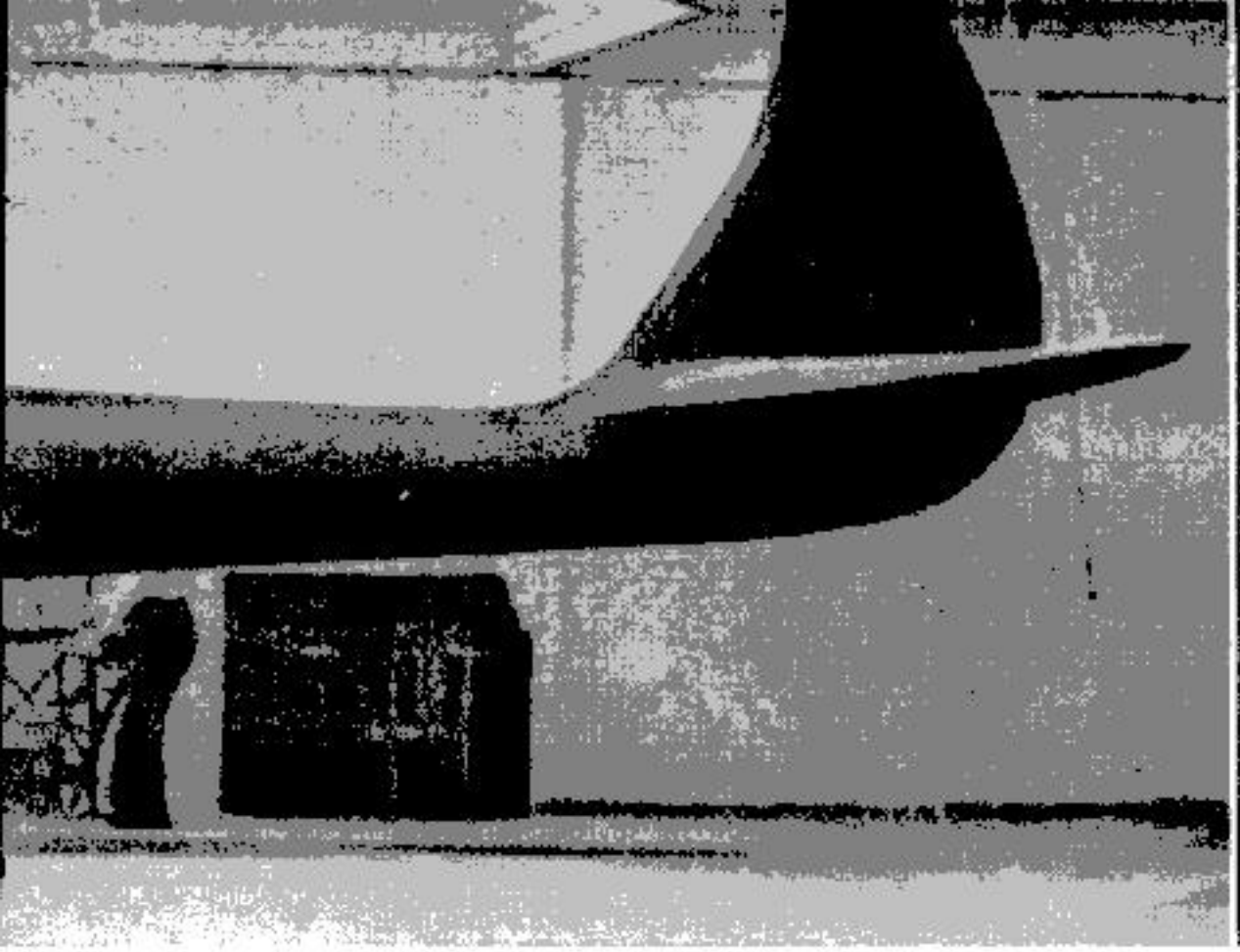
NAMED the Manta after the giant ray fish it resembles, an American fighter plane of extraordinary design will be test-flown this summer by the Manta Aircraft Corp., of Los Angeles, Calif. Designers maintain that it can cross the Atlantic Ocean nonstop, or climb to 40,000 feet in 18 minutes, combining the performance of a long-range bomber and an interceptor. Striking among its innovations is a "contra-prop," a pair of tandem propellers turning in opposite directions on concentric shafts as illustrated in the drawing below.

An importation from abroad, the contra-prop has already found favor with leading European aircraft makers. Engineers regard it as one of the coming things in aviation, for at least half a dozen convincing reasons.

Motors of 7,000 and 8,000 horsepower now appear no more fantastic than current models of 2,000 horsepower or more seemed a few years ago. Hitched to engines of constantly increasing size, single propellers



In the new Manta plane, twin propellers are geared to the liquid-cooled engine, which is placed at the plane's center of gravity. Concentric shafts, the outer one hollow, drive props opposite ways



A factory mock-up of the Manta. Designed as a long-range fighter, the first model is scheduled to be test-flown this summer

• • •

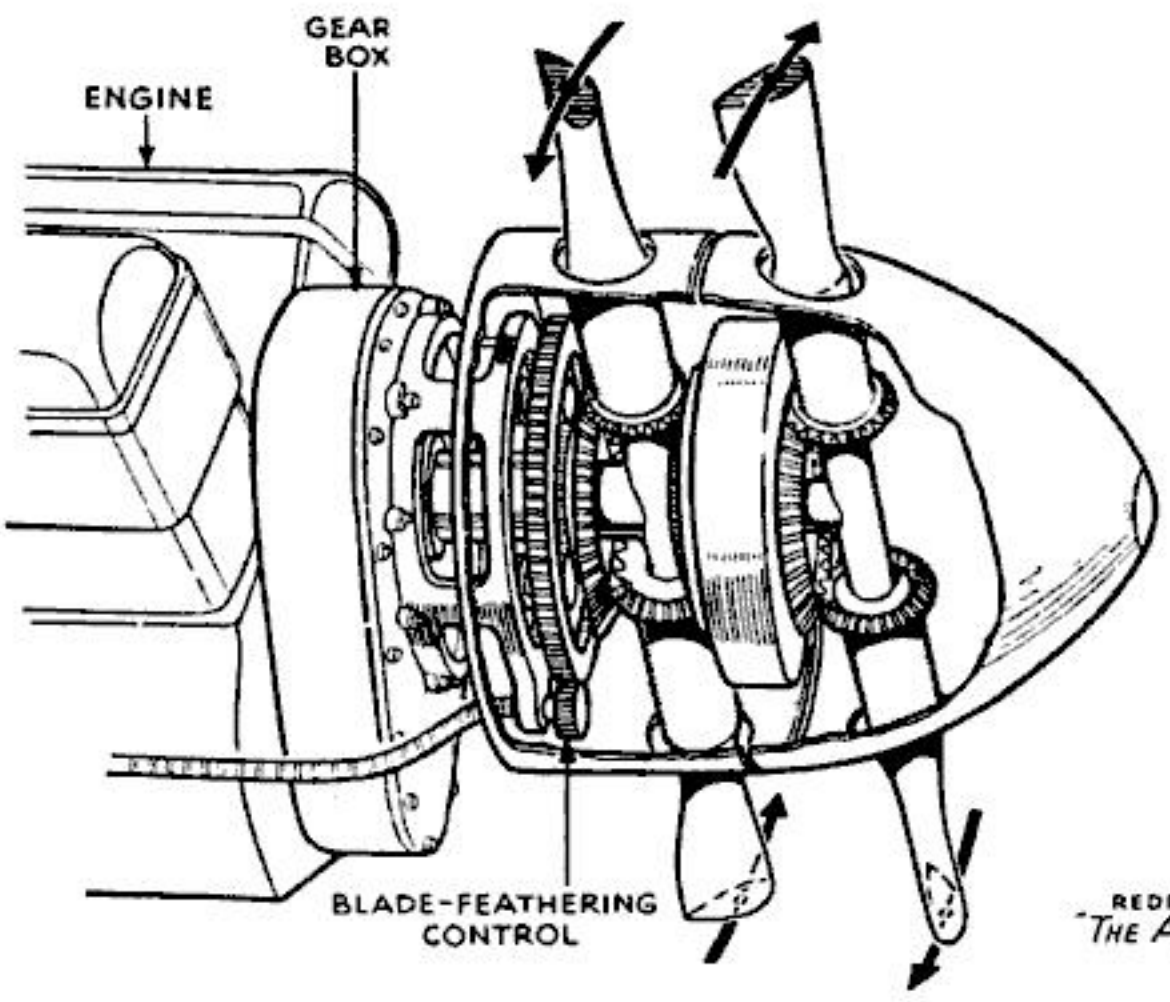
Contra-Rotating Props

would soon be forced to attain outlandish dimensions—or else use too many blades for propulsive efficiency. The contra-prop, taking equal hold on the air with smaller size and number of blades, sidesteps the difficulty.

In present-day craft, contra-props reduce propeller size, giving a pilot better vision; permitting shorter and lighter landing gear to keep them from the ground; and lowering tip speed, a desirable result from an engineer's viewpoint.

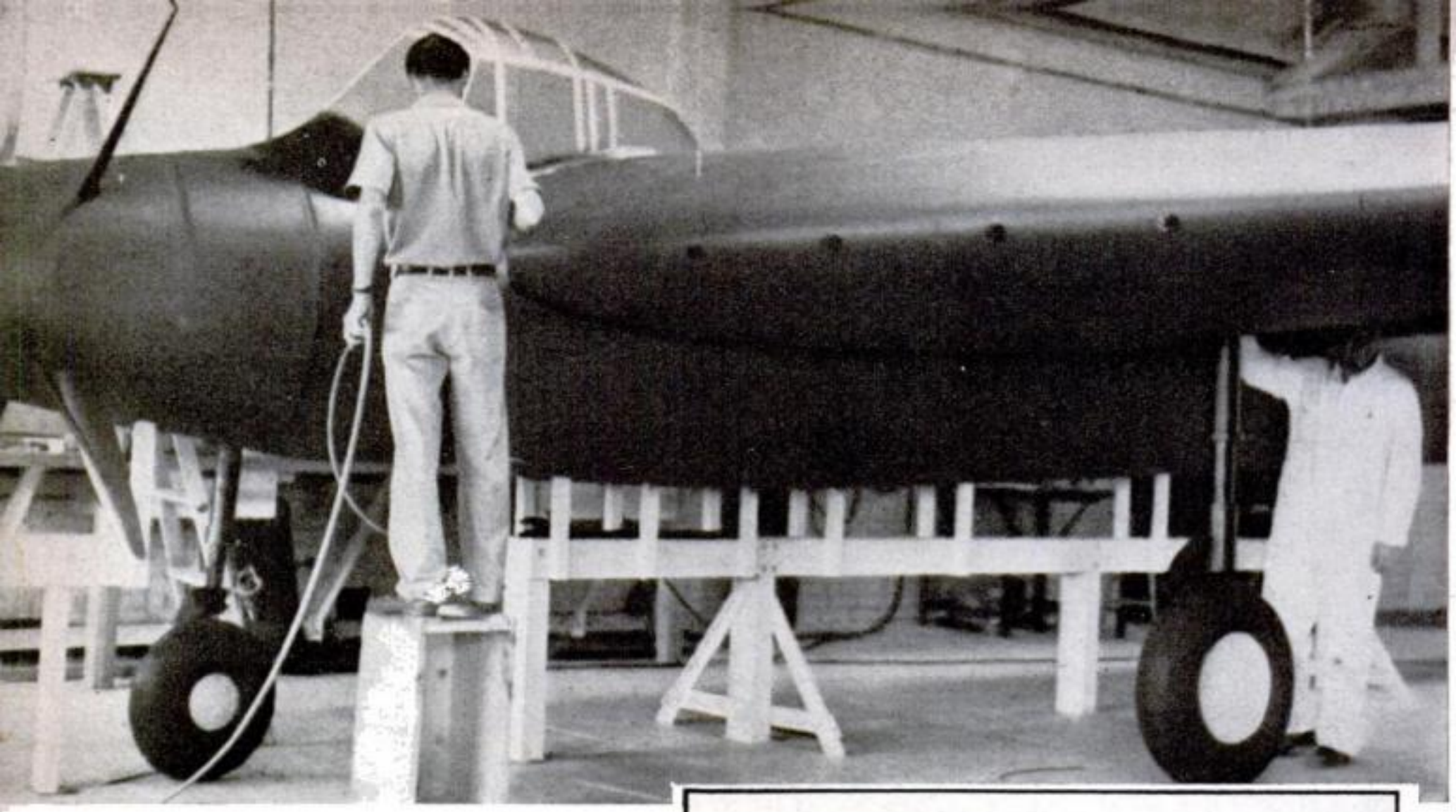
Opposite rotation of the contra-prop blades eliminates torque, the twisting force with which a single propeller would tip a plane sideways, were it not for corrective control surfaces that impose an appreciable drag. Dispensing with these gives added speed.

For swift maneuvering in aerial dogfights, weight is best concentrated near the center of the ship, as in the Bell Airacobra, by placing the motor behind the pilot. An accompanying diagram of the

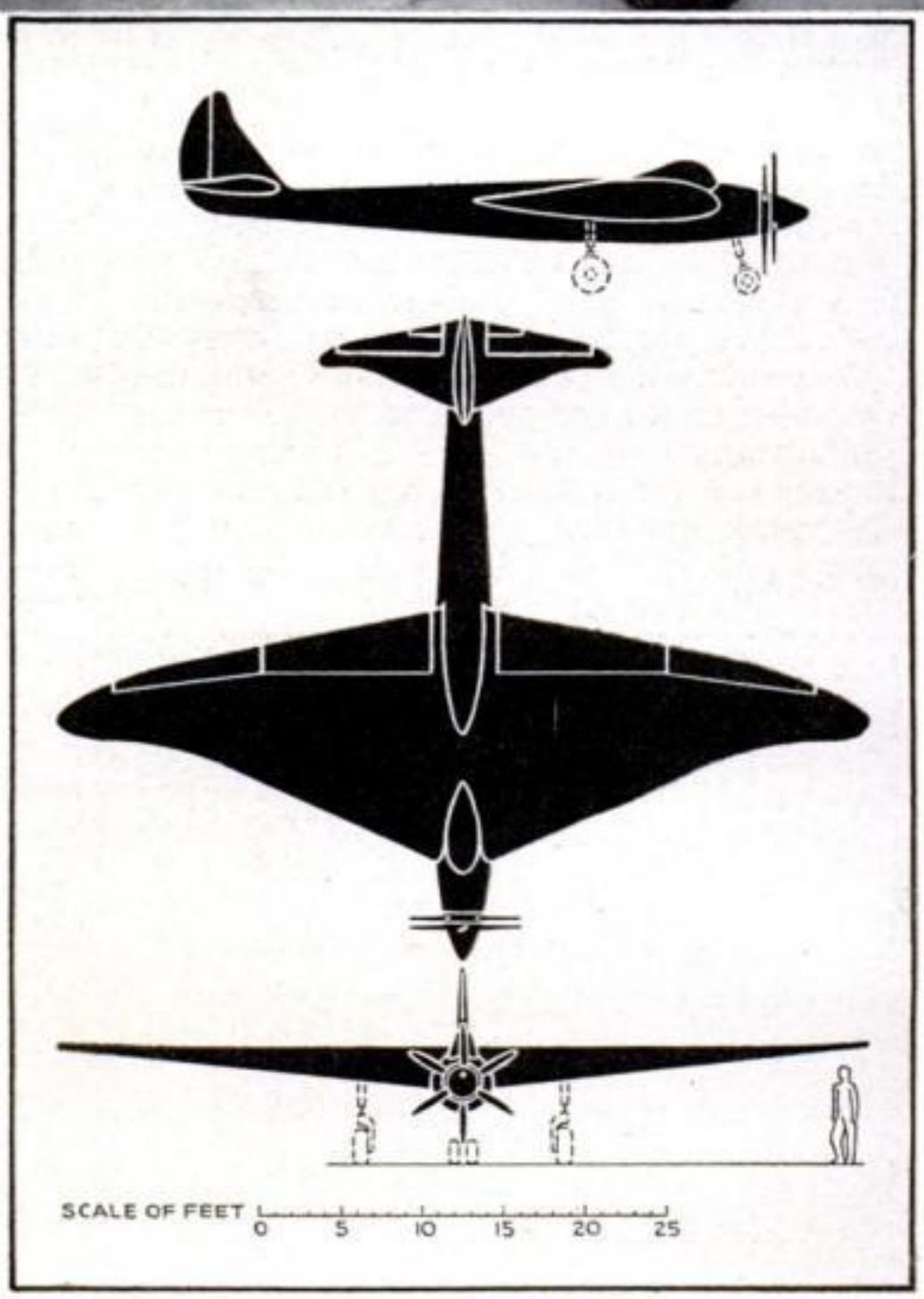


This diagram shows the operating principle of a British contra-prop design which provides for feathering blades. As in the Manta, drive for the propellers is through two concentric shafts. Arrows indicate opposite motions of the front and rear propellers, which turn with the nose sections. The gearing for feathering represents a simple solution for what was at one time a perplexing problem in mechanics

REDRAWN FROM "THE AEROPLANE"



Mock-up shows wing ports for cannons and machine guns. Resemblance to ray fish in silhouette (right) gave the plane its name



new Manta plane shows how well the same arrangement lends itself to use of a contra-prop with the pilot astride the drive shaft.

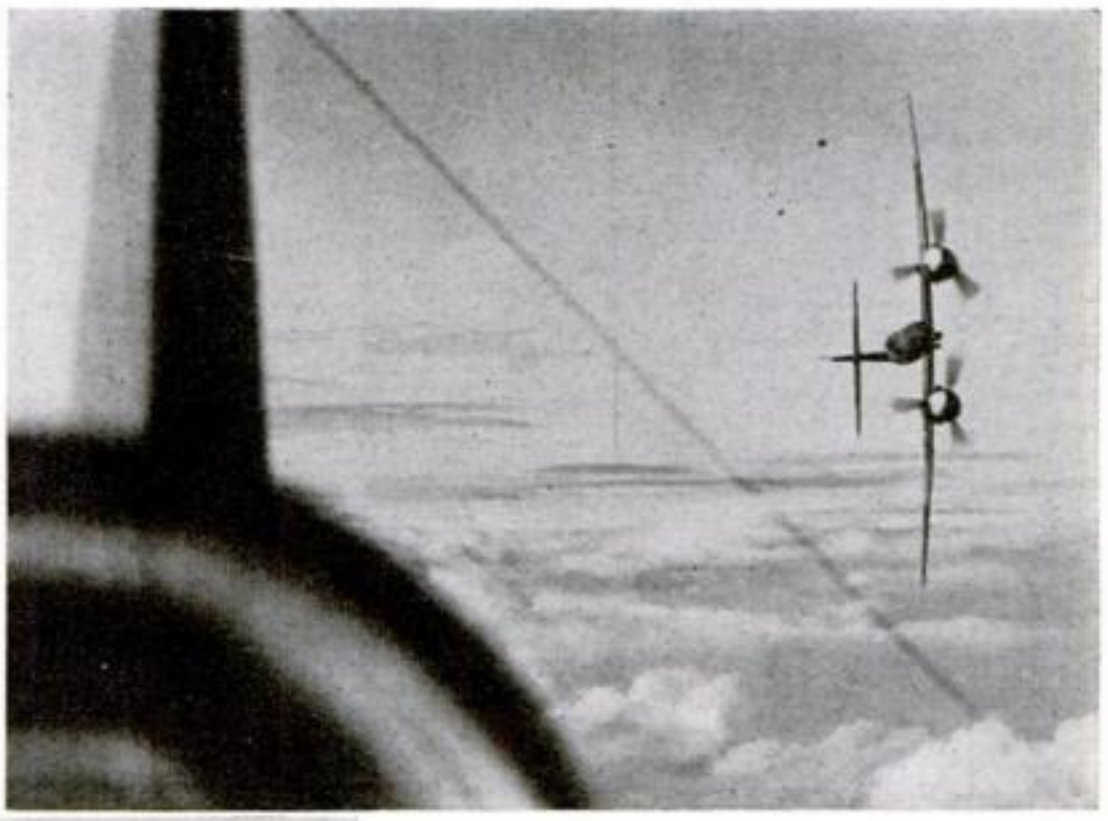
Spurred by these considerations, warplane builders have been racing to solve the mechanical problems of driving contra-props. So well have they succeeded that the mechanism now includes the modern refinement of "feathering" the blades. The Fairey works in Britain claims to have been the first to fly planes with variable-pitch contra-props, which may also be built into the Manta. Wind-tunnel tests of a model of the new American ship indicate a cruising speed of 350 miles an hour and a top speed of 430 miles an hour, using a 1,150-horse-power liquid-cooled motor; and armament consists of four 20-millimeter cannon and four .50 caliber machine guns. Unconventional as the wings appear in surface shape, their cross section is that of the famous "Davis wing," designed by David R. Davis, vice president of the Manta organization. This wing is based upon a mathematical formula which produces airfoils of great lifting efficiency.

Welded steel tubing forming the framework of the craft will be covered with a smoothly molded plastic skin. To transform the craft from a fighter to a dive bomber, only a few minutes are needed to remove sections from the lower wing covering and mount the bombs in place. Fully loaded and fueled, the Manta can remain aloft 10 hours and cover a distance of 3,500 miles to accompany other bombers on long-range missions, or to serve as a bomber or fighter itself.

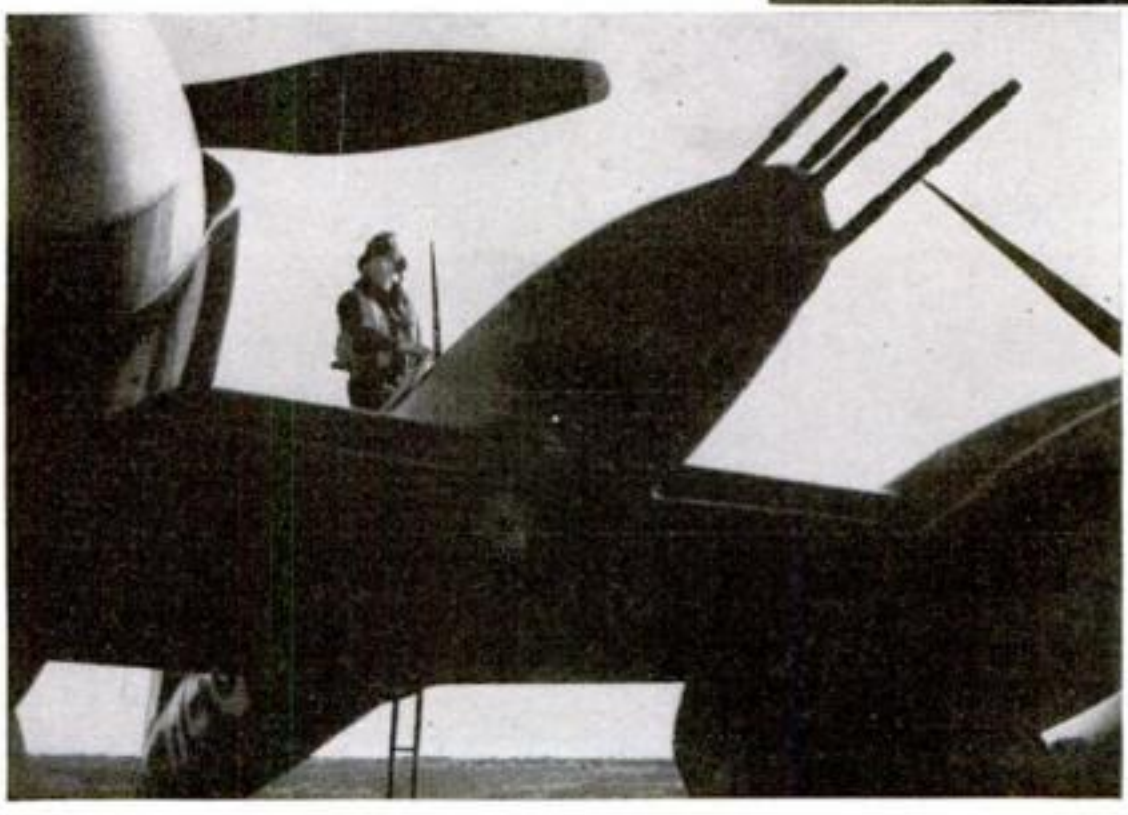
A Westland Whirlwind in flight. Planes of this type are playing an increasing part in Europe's air war

Flying Arsenals Pace Bombers on Raids

CAPABLE of speeds well over 350 miles an hour, Britain's Westland Whirlwind long-range single-seater fighter plane is an important member of the R.A.F. bomber escort. A low-wing monoplane, the craft is powered by two 850-horsepower Rolls Royce engines and armed with four deadly 20-mm. cannon mounted in the nose. From tip to tip, the wing measures 45 feet, while the fuselage is 32 feet, three inches long and stands 10½ feet high. An interesting feature is the tail unit, which is set well above the fuselage in the high fin. Although the "Whirlwind" has been operating for some time, its specifications have just been released. These fighters escorted bombers as far as Antwerp in recent raids over Cologne, giving them protection against German interceptors based on the Belgian coast.



Standing on one wing, one of the fast twin-engine single-seater fighters takes a sharp turn. This craft has a long range



Four 20-mm. cannons in the nose give formidable hitting power against enemy pursuit ships attacking bombers

AMERICA'S TANK FAMILY

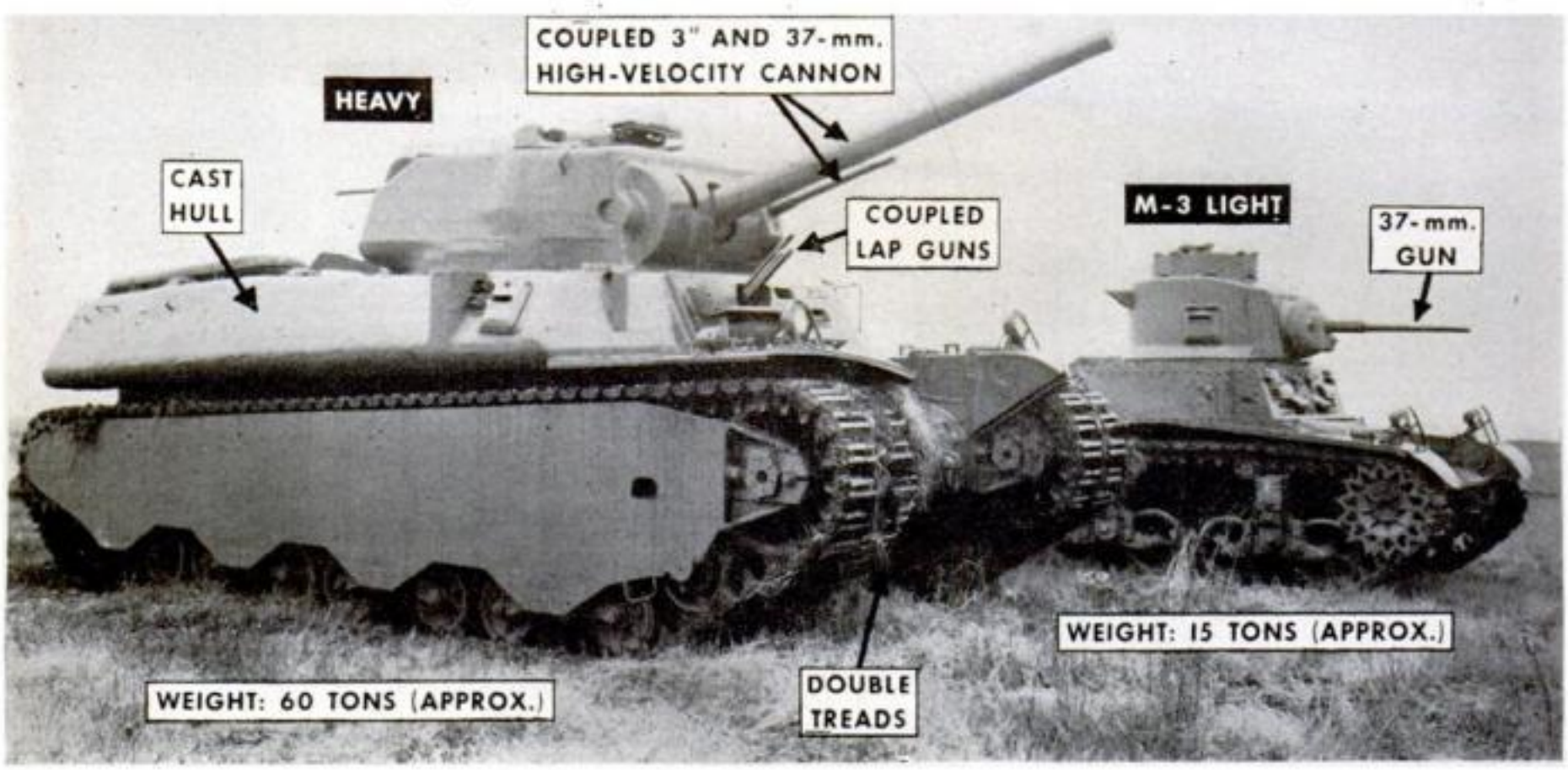
Its Newest Member, the Versatile M-4 Medium, Goes into Production

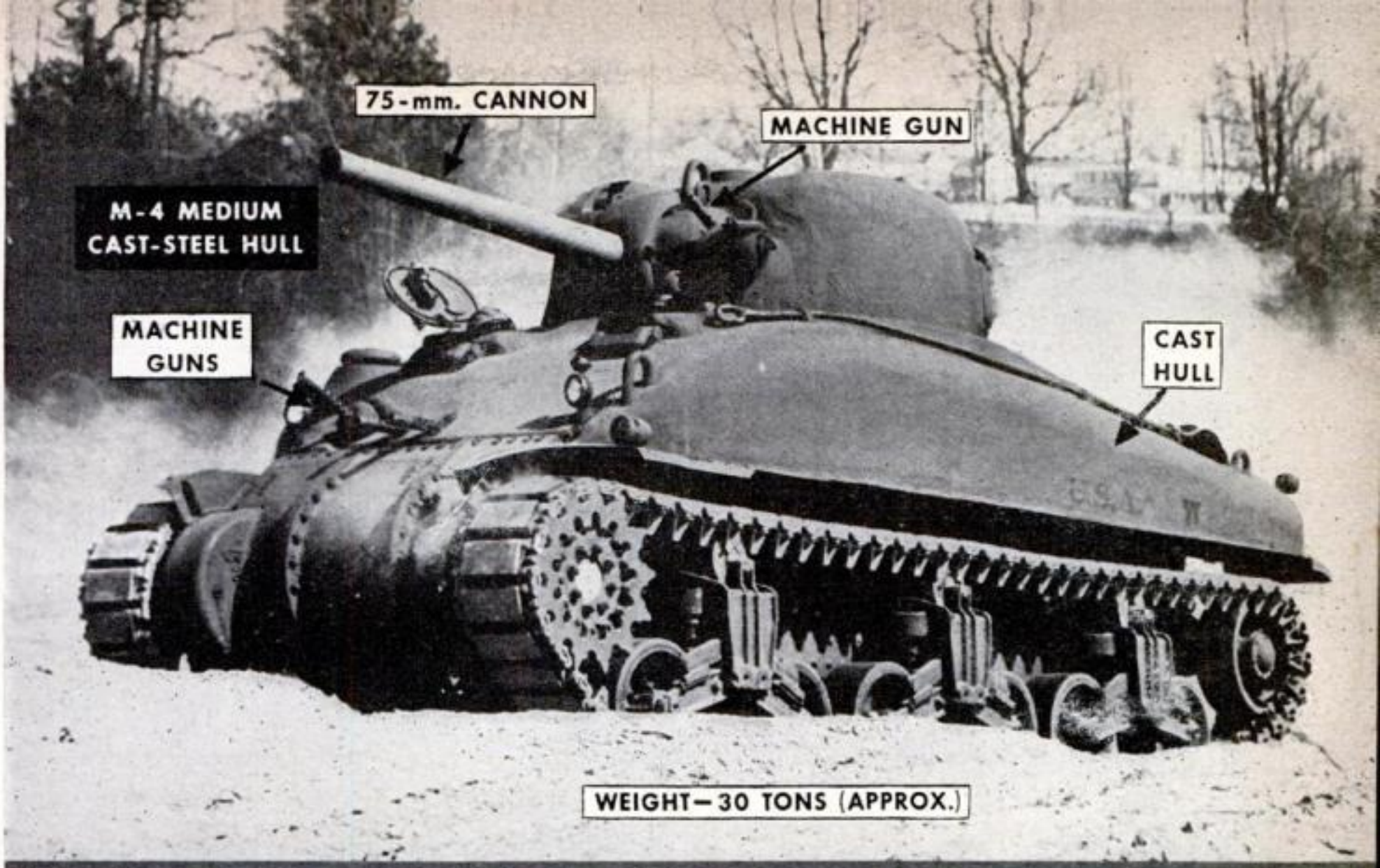
WITH the new M-4 Medium tank rolling off the assembly lines, the U. S. Army now has a complete, all-purpose tank family. Ranging from the 57-ton Heavy to the fast and maneuverable 15-ton Light, these tanks are said by observers to be a match for anything the enemy has.

The new M-4 Medium tank is now being turned out in two models—one with a cast-steel hull and turret, the other with a cast-steel turret but an all-welded hull. Both provide a low silhouette. Its armament consists of a 75-mm. cannon and a battery of machine guns. The cannon is mounted on a turret with full 360-degree traverse.

A tough predecessor of the new tank is the 28-ton M-3 Medium, nicknamed the "General Lee" by the British. Capable of good speed even over rough ter-

The two extremes in America's tank family. Above, and below at left, the well-armed and armored Heavy and, at the right below, the M-3 Light with its cast-steel turret and riveted hull. Turrets on both tanks have 360-degree traverse. Notice the double treads on the Heavy, single tread on the Light





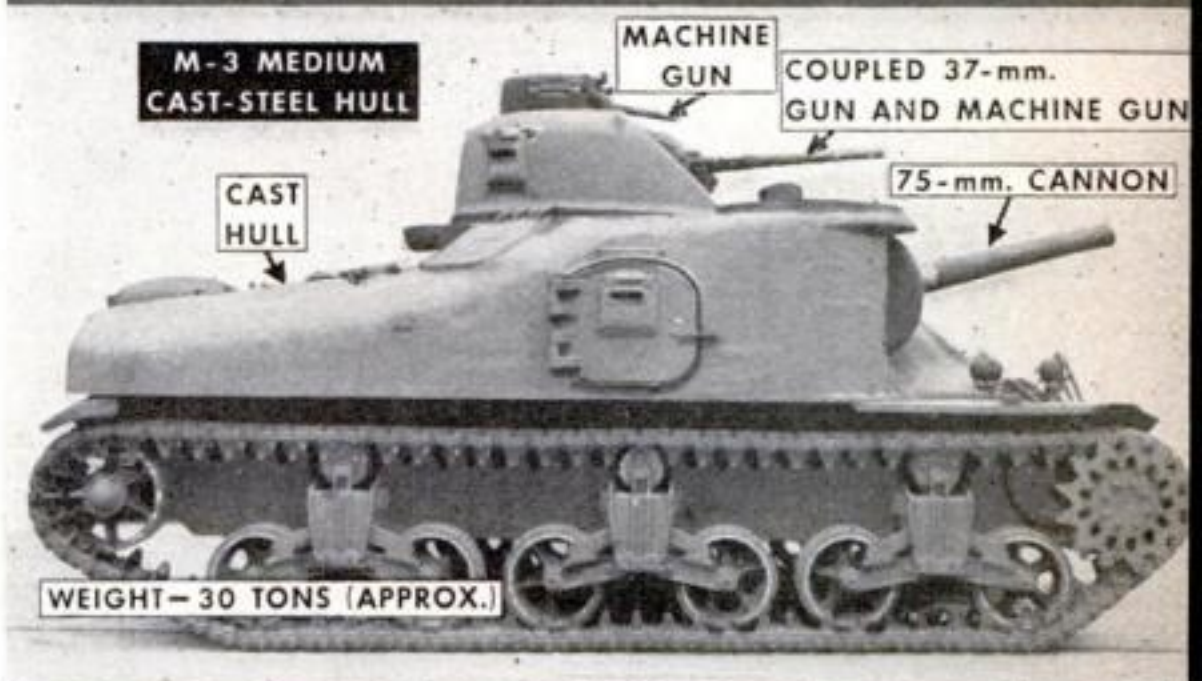
The newest member of the family — the M-4 Medium. Cast-steel hull and cast-steel turret mounting a 3" cannon makes this the Army's most versatile tank. It weighs no more than the earlier M-3 Medium models shown below, and its 360-degree turret, high-velocity cannon, and low silhouette make it a powerful weapon

rain, the M-3 is armed with a 75-mm. and a 37-mm. cannon as well as machine guns. Although originally built with riveted bodies, late models are of cast-steel construction, eliminating the danger of rivets flying around inside when the tank is hit by shellfire.

Lightest of the American tanks is the 15-ton M-3 Light. Known to the British as the "General Stuart," it has won high praise in the Libyan campaign with its high speed, good maneuverability, and mechanical excellence. It is armed with a 37-mm. cannon in a revolving turret, and a number of machine guns. Experts say that under some conditions it can cope on an even footing with Germany's medium tanks.

Giant of the U. S. tank family is a 57-ton monster armed with one 3-inch cannon, one 37-mm. cannon, and machine guns mounted both fore and aft. Designed to repel enemy tanks, it has an exceptionally high speed for its weight. The 3-inch and the 37-mm. cannons, which are coupled, are mounted on a revolving full 360-degree traverse turret and both turret and body are cast.

This early M-3 Medium had a riveted hull, a cast top turret for its 37-mm. gun, and cast side turret for its 75-mm. cannon



On this later model of the M-3 Medium, the hull as well as turrets is cast. Rounded shape increases bullet ricochet

WHAT YOU CAN DO FOR VICTORY

Craftsmen Volunteer Skills

GOVERNMENT EXPERTS ARE IMPRESSED BY THE WHO ARE CAPABLE OF HIGH-PRECISION WORK AND

This small New Jersey machine shop, which normally makes dies for tiles, is a member of the pool conducted by the Sloane-Blabon Corporation. At right, one of its employees is machining a heavy nut for a war tank

By ARTHUR GRAHAME

THE nation-wide survey of home-workshop and small-machine-shop man power and manufacturing facilities being made by POPULAR SCIENCE has proved that there are many thousands of Americans who know how to make things, and who own the tools to make them with, who are patriotically eager to use their skill and their equipment to help make our mighty win-the-war production drive a resounding success.

Government production experts are deeply impressed by the large number of registrants—many of them hobbyists—capable of high-precision work, and by the great reserve of efficient machine tools brought to light by the registration forms which continue to come in from all over the country.

Equally impressive is the eagerness and impatience to get into the production battle which is expressed in the letters that accompany many of the registration forms. Typical of these letters is this one from a man who works and lives in a New England manufacturing town:

"I am working 55 hours a week on war production, but I feel that I should do more in this gigantic effort. No red-blooded American wants to come home from his work and listen to the radio urging production in all its phases while he sits idle and lounges away the evening."

This letter is from a Minnesota hobbyist who is the owner of a well-tooled-up home workshop:

"I am a member of the police department, in the detective bureau. Among my fellow employees there are a number who were recruited from the machine shops during the depression years, and who, like me, are anxious to utilize their experience in the production drive to win this war. My plan is to use these men on short shifts of from four to

and Machines to Aid War Production

LARGE NUMBER OF REGISTRANTS IN THE POPULAR SCIENCE SURVEY BY THE SUPPLY OF SMALL BUT EFFICIENT POWER TOOLS IN THEIR SHOPS

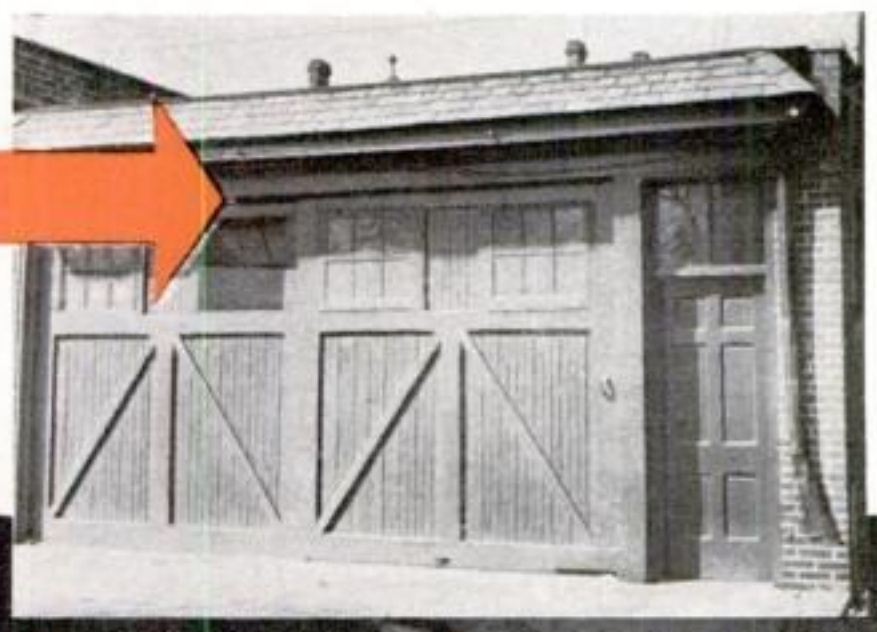
six hours, which they can handle without impairing their efficiency on their police jobs, and so to fully utilize my machine tools for war production. I also have the services of a machinist of over 50 years' experience, who was a machinist, first class, in the Navy during the Spanish-American War. He is retired now, but being my dad he is willing to assist me in this project."

As soon as POPULAR SCIENCE receives registration forms and records the information contained in them they are sent to the War Production Board in Washington, for whom this survey is being made. WPB is anxious to increase war production in every practicable way, but obviously there are many serious difficulties to be overcome before this army of volunteer workers and their arsenal of tools can be mobilized efficiently on a national scale—before thousands of home craftsmen who individually can produce only small quantities of bits and pieces of armament can be meshed in with the mighty driving wheels of great manufacturing plants or of whole industries converted to war work.

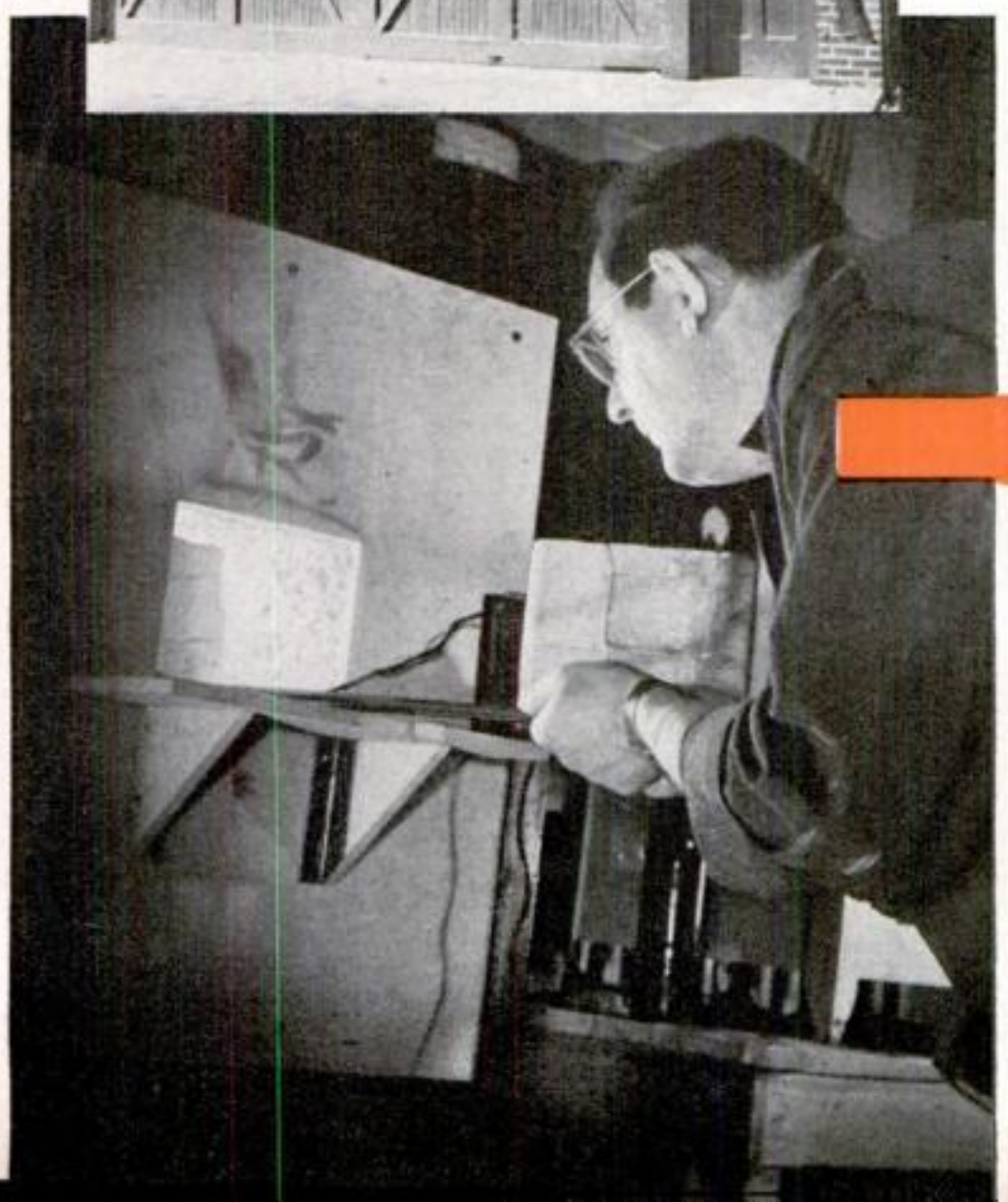
We think that these difficulties can be overcome—just as Stanley Carlson overcame them in his pioneering work in Passaic, N. J. We are convinced that they should be overcome.

But let us repeat a word of caution. At present neither WPB's Washington headquarters nor its field offices have facilities for handling home-workshop subcontracting. Calling at or writing these offices won't help you get a contract, and will slow down the production effort.

That caution applies only to WPB offices

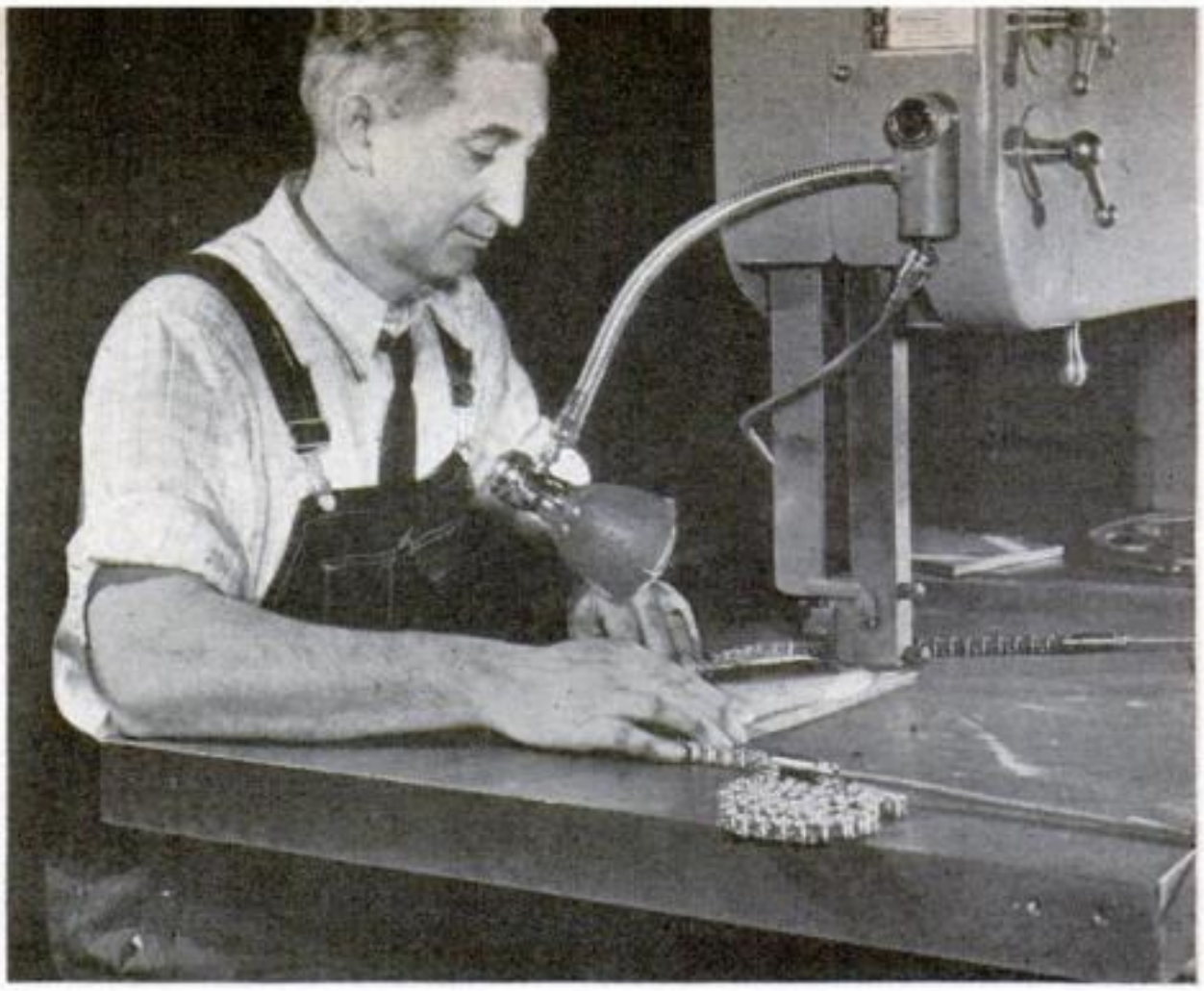


Machined parts go to the garage shop at left for heat treatment. This establishment makes electric furnaces, and now uses its own products in war work as shown at the lower left



Back to the "mother hen," which originally furnished all the materials, come the parts that have been prepared by the various members of the pool. Here, as on the assembly line of a single factory, they are given any finishing touches and finally put together

A welding operation at the Sloane-Blabon plant. This firm, one of the country's largest linoleum manufacturers, acts as the nerve center of the pool



A machine operation at mother plant. The pool form of subcontracting has the advantage of linking together a large number of small shop units under the supervision of a large organization which can direct their work and assemble their products

—not to manufacturers who have war-production contracts. If you have tools and the skill to use them, don't hesitate to ask any prime contractor or subcontractor for work which you are confident you can do. You'll have to sell yourself, of course, but the pressure is on these days, and most firms doing Government work are more than glad to farm out small parts to "little fellows" who they think can do their work satisfactorily and on time. Many home-workshop hobbyists and owners of small machine shops and other small plants have obtained war work because they were enterprising and aggressive enough to go out after it.

One of these enterprising home craftsmen is Philip H. Wells, an engineer with Western Union in New York who has made metalworking his hobby since he used to work in machine shops during his college vacations. The day after Pearl Harbor he added two second-hand lathes to the lathe, two drill presses, and grinder in the shop in his suburban home. Then he went to a manufacturer engaged in war production and got a subcontract—after he had produced a satisfactory sample of a small part. Then he trained two assistants to do the work. Now he devotes his evenings to giving instruction in machine-tool work to anyone who is interested—there are businessmen, gas-station attendants, and salesmen enrolled in his informal class.

Many owners of small machine shops and other small plants—shops employing up to about a dozen men—have sent in war-work registration forms. One of them is a New Jersey man, the chief designer of a machinery-manufacturing firm, who expanded his hobby home workshop into a profitable side-line business of making special tools for manufacturers of archery equipment. He has a well-equipped shop, and several skilled workers. Another registrant is the owner of a photoengraving shop in an Iowa city. Fearing a shortage of copper and zinc for his regular business, and wanting to keep his workmen in his employ, he is trying to obtain war contracts.

While WPB field offices at present do not have facilities for handling home-workshop

REGISTER FOR WAR WORK

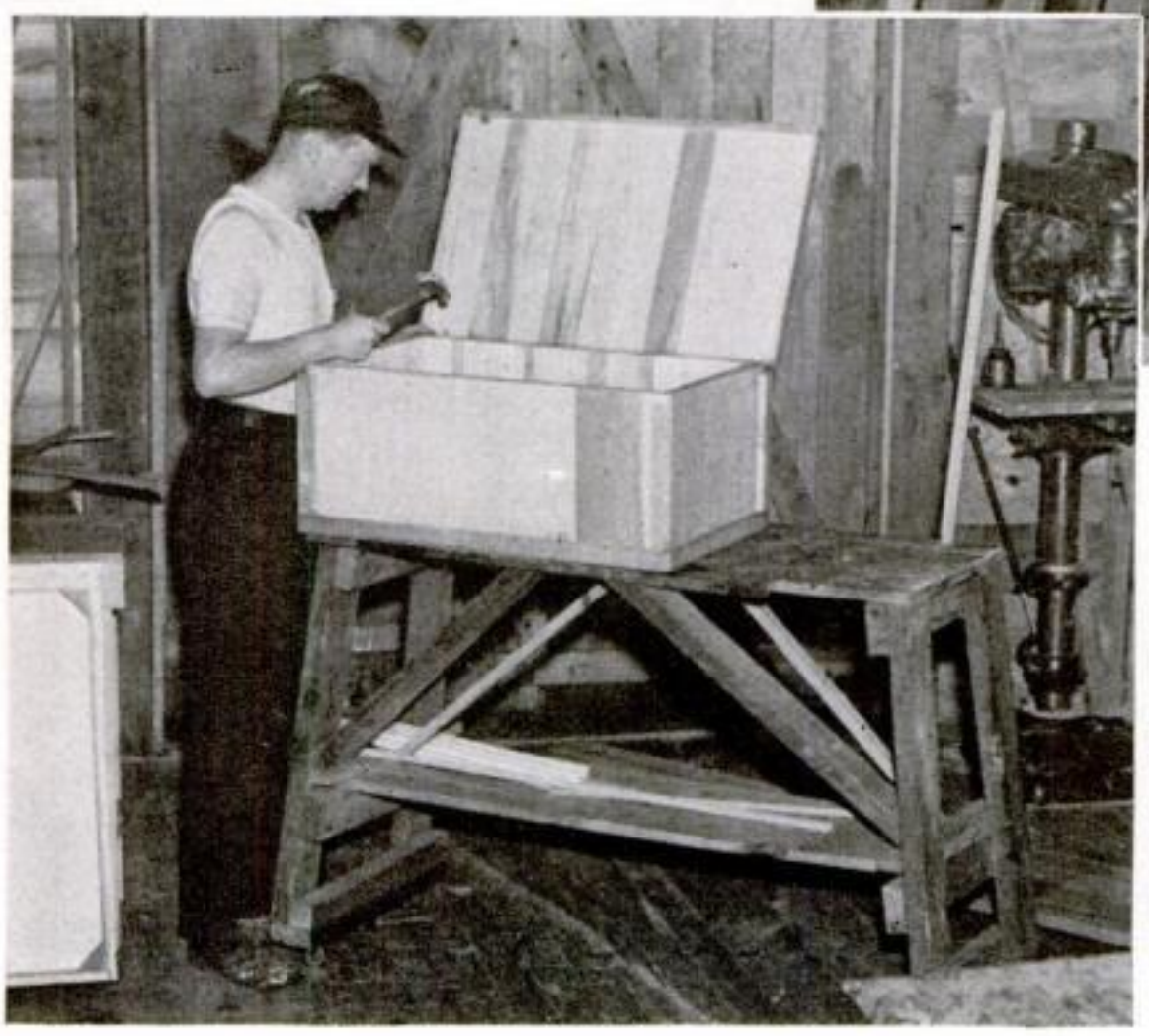
If you have a well-equipped home workshop or are the owner of any type of small shop suitable for producing "bits and pieces," you should register in the survey being conducted by this magazine for the War Production Board. Write to War-Work Registration, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, for a registration form, and inclose a stamped, self-addressed envelope. The blank has spaces in which you can list your shop equipment and indicate the kind of work you are best fitted to do. Act at once . . . write today.

subcontracting, they often are able to help well-established small plants obtain subcontracts or even small prime contracts, and owners of small machine shops should not hesitate to make use of their services in trying to obtain war work. On the staffs of most of the field offices there are engineers and production experts who give would-be contractors technical advice, and many of the offices have exhibits of parts that are needed by Government procurement agencies and by prime contractors.

Production pools of various sorts, of which there now are about 50 in operation, have brought many small shops into the armament drive. One of the most successful of them is the Central New Jersey pool, with its headquarters in Trenton. This is a "mother-hen pool" of the sort which has been very successful in Great Britain. Its "mother hen" is the Sloane-Blabon Corporation, a large linoleum-manufacturing company which is short on machine-tool capacity but long on capital, engineering and management skill, and mass-production experience. There are about 40 smaller plants, some of them small machine shops, in the pool. Sloane-Blabon has obtained large prime contracts for ordnance items. The "mother-hen" company supplies the material for making parts, and each pool-member shop concerned with the manufacture of a particular part does its specific job on it and then passes it on to another pool member. When the parts are finished they are assembled in the Sloane-Blabon plant.

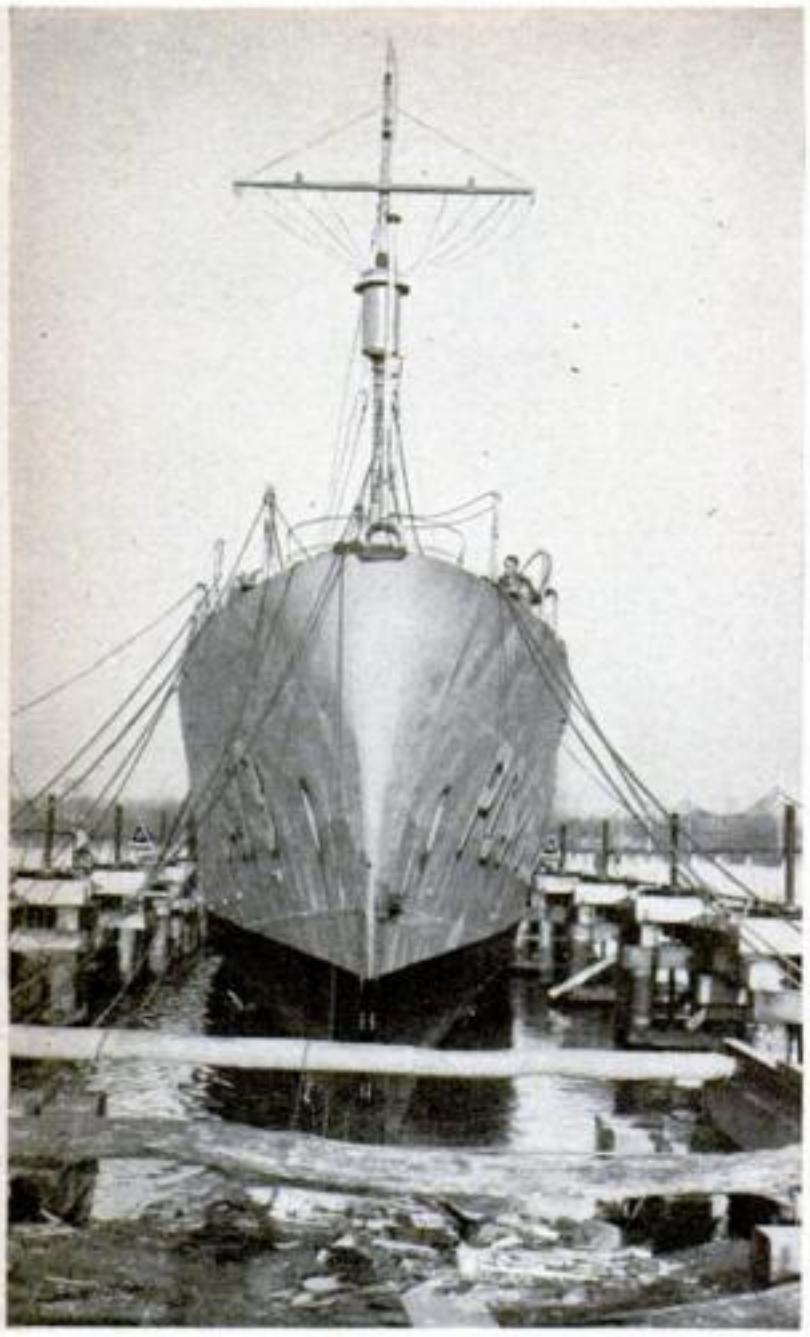
Many automobile dealers who thought that they had received a knockout blow when the sale of cars was restricted are finding that they can stay in business by reconditioning old machine tools, and converting their shops and even their sales rooms into war-production plants. According to a survey made by Willys-Overland among 40,000 dealers, a half billion dollars worth of machine tools owned by them can be put to war work.

All over the country, Americans who have machine tools and who know how to use them want to get to work on the big job of helping to win the war.



Morris Saslawsky, "one-man war-production plant" of Delancey Street in New York, enters his morning's output in a record book before sitting down to his lunch. His job is to weld a flat steel piece to a round one. He doesn't know what they're used for, but he has done over 1,000 units without a rejection

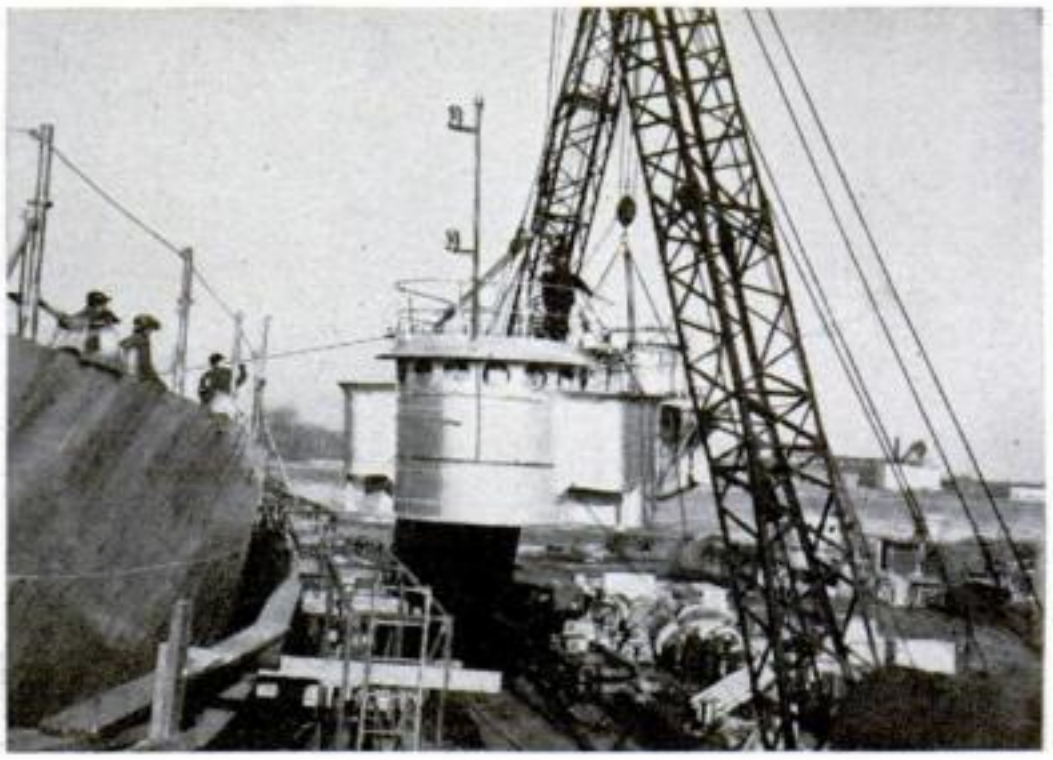
A Georgia dental supply salesman working in his hobby shop on a defense job. He is building a tool chest which will find its place on an aircraft carrier



Completed one week after its keel was laid, this submarine chaser is launched on a novel table. Right, workmen swing superstructure on after hull is righted

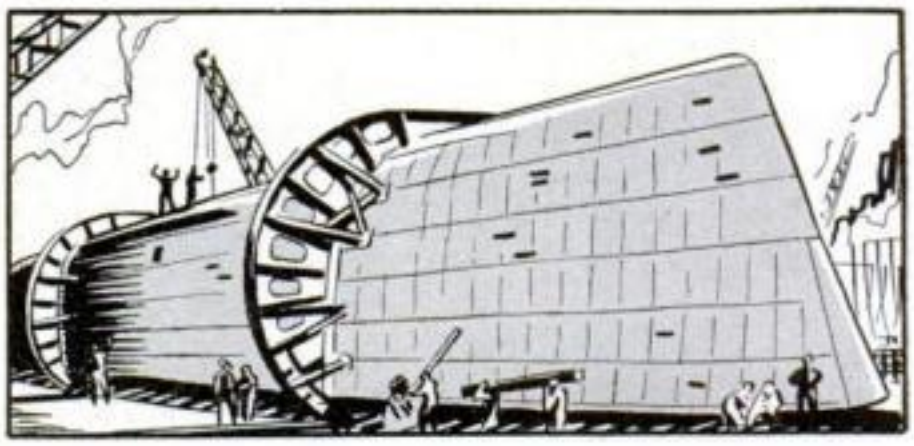
Patrol Boats Are Built Upside Down to Give Navy New One Each Week

RUSHING the assembly of light patrol boats and submarine chasers to the rate of one a week is accomplished by a new technique in which the hull is built upside down and then righted for the installation of superstructure. The upside-down method of construction enables welders to work more conveniently and speedily with the plates under their feet. When the hull is completed, a special "rocker cradle" is fixed around the shell, which is then rolled over. Construction of larger ships by this method has not been attempted because of the difficulty in righting them.

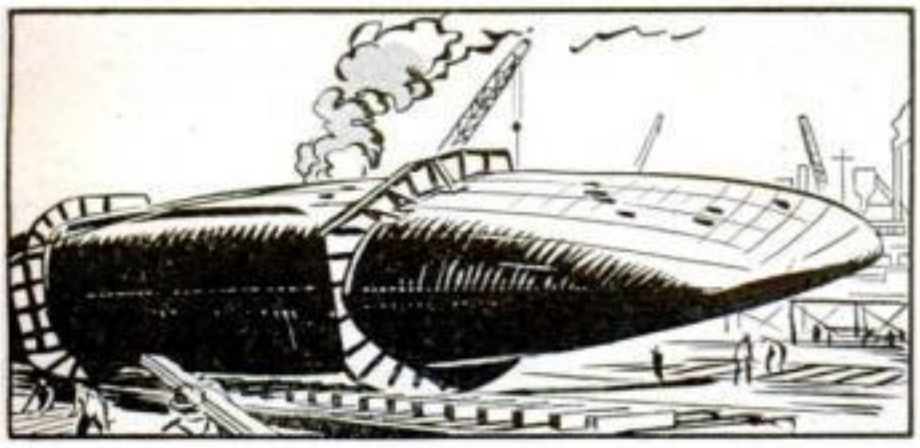


Steps in Assembly-Line Construction of Small Patrol and Fighting Ships

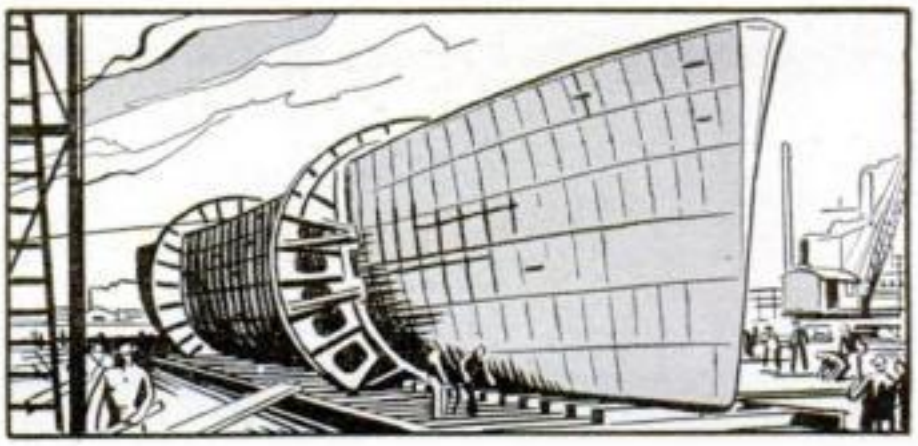
1 Beginning construction on the assembly line. A crane swings the prow into its place . . .



2 . . . The hull completed, a specially designed "rocker cradle" is fitted to its sides . . .



3 . . . Now the hull is rolled over. The job so far has been done in record time . . .



4 . . . And the little ship sits right side up on its launching table, ready for the superstructure

Five Medical Miracles—*the Sulfa Drugs*

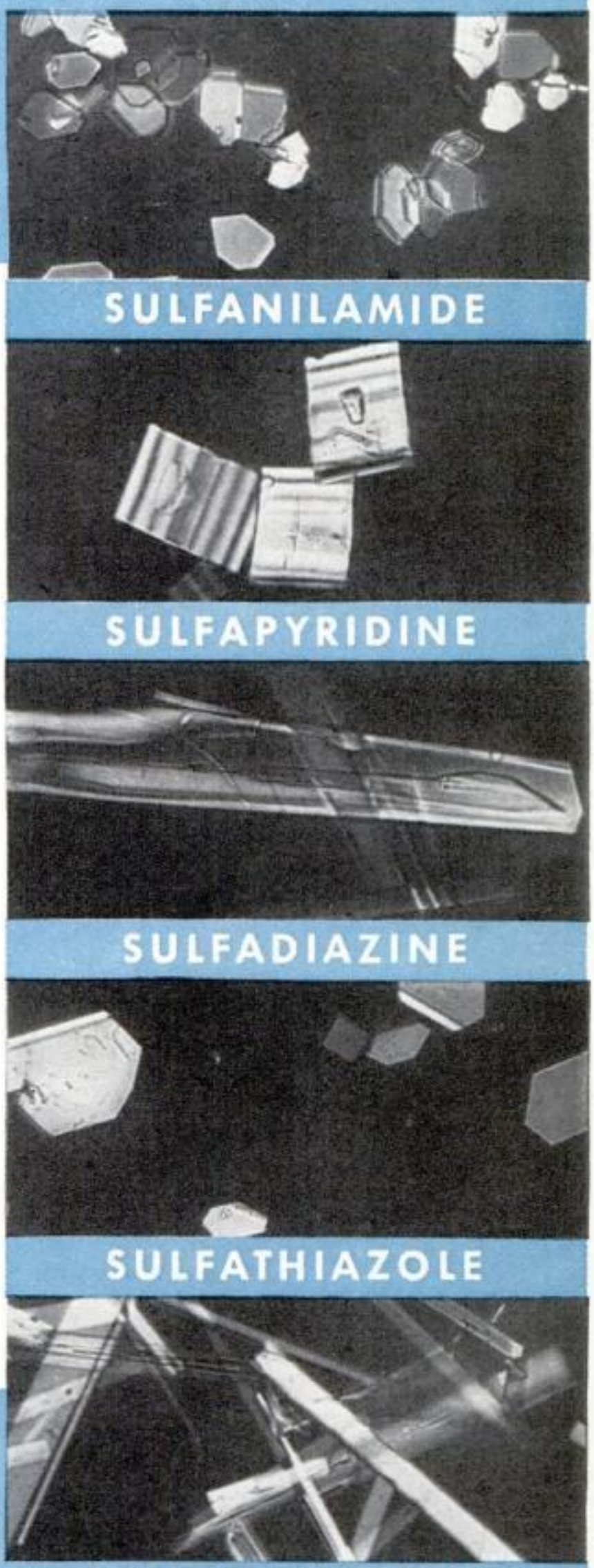
Chemical Blueprints Reveal How Atoms Fit Together in These Powerful New Weapons Against Infection and Disease

By CARL DREHER

CARBOLIC acid is an antiseptic. It kills "germs"—microörganisms which cause infection. If we could dip a man into strong carbolic acid, all the germs in his body would be dead in a short time. But the man would be dead too, for the stuff is as damaging to healthy tissues as to the microscopic plants and animals which made him sick in the first place.

That, roughly, is the problem of asepsis. Since the time of Pasteur, physicians have been looking for an antiseptic which would be poisonous to the invaders and not to the invaded—a specific against bacterial aggression. Or, if that proved impossible, they would have been glad to settle for something that would be *less* poisonous to the attacked organism than to the attackers, so that there would be a net gain. And now the latter problem is approaching a solution: sulfanilamide and its kindred compounds. The sulfa drugs constitute a powerful new weapon in man's agelong fight against disease.

This is not to say that the battle against infection has been won. For a large number of ailments—typhoid fever, acute rheumatic fever, smallpox, influenza, tuberculosis among others—the sulfa drugs have so far proved unavailing. They have their disadvantages. They are poisonous, mildly so for some people, very seriously for others. All powerful drugs require judgment, skill, and experience in administering; this is as



Meet the sulfa family: photomicrographs show crystals of sulfanilamide and its four relatives. Although science cannot explain exactly how they behave in the human body, there is no doubt of the beneficial results

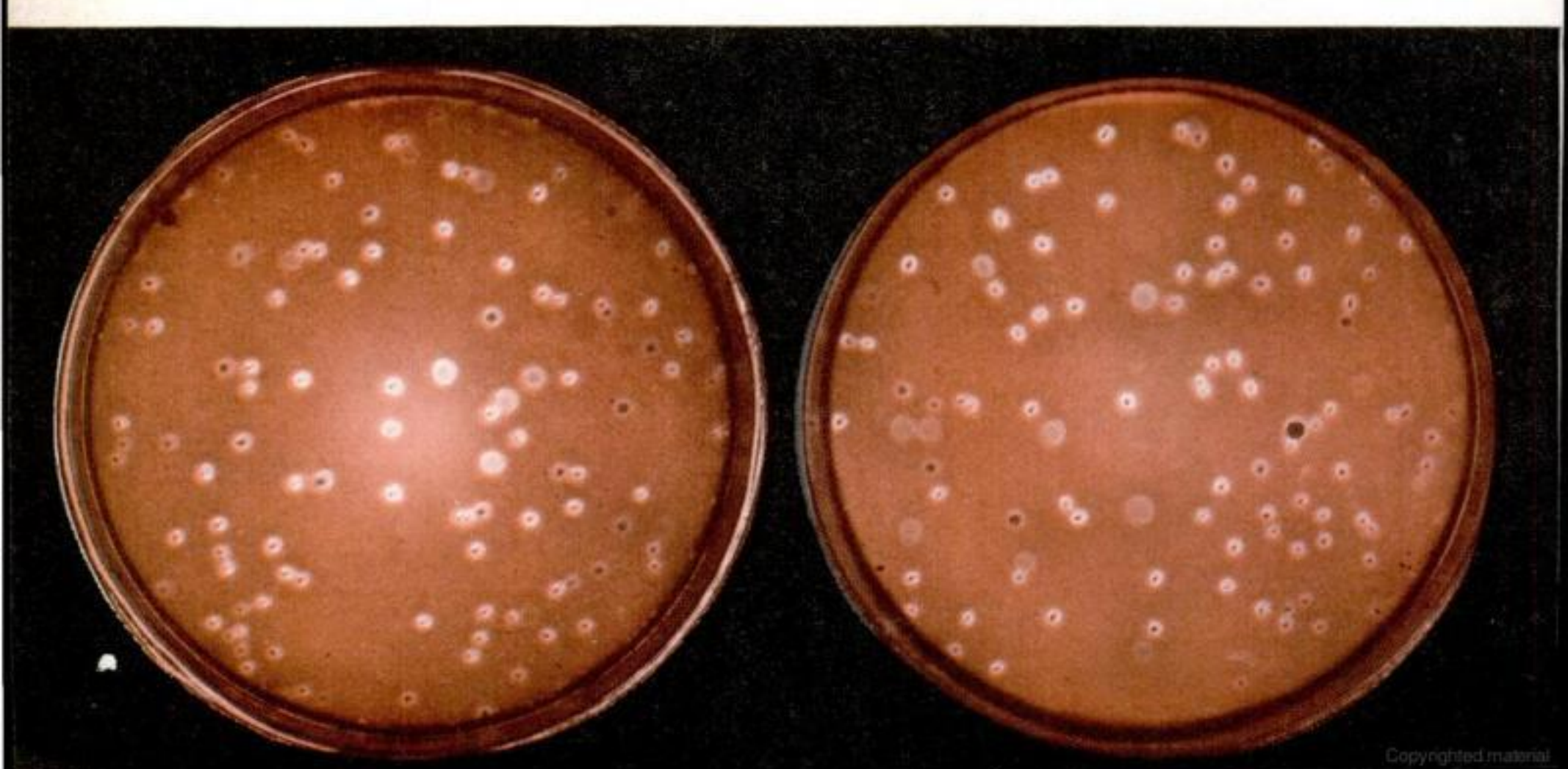
true of the sulfa series as of older medicines.

But when these reservations have been conscientiously stated, the sulfa drugs still constitute a medical miracle. They have drastically cut the death rate and time required for recovery in a great number and variety of diseases, including some of the gravest—meningitis, pneumonia, blood poisoning, childbed fever—and in others which are often incapacitating and dangerous, such as erysipelas, urinary-tract infections, bacillary dysentery, skin diseases, trachoma. They are invaluable in prophylaxis, and are now being used as a routine precaution against peritonitis following abdominal operations. And in new forms they may prove effective against ills which have so far yielded neither to them nor to the older methods of treatment.

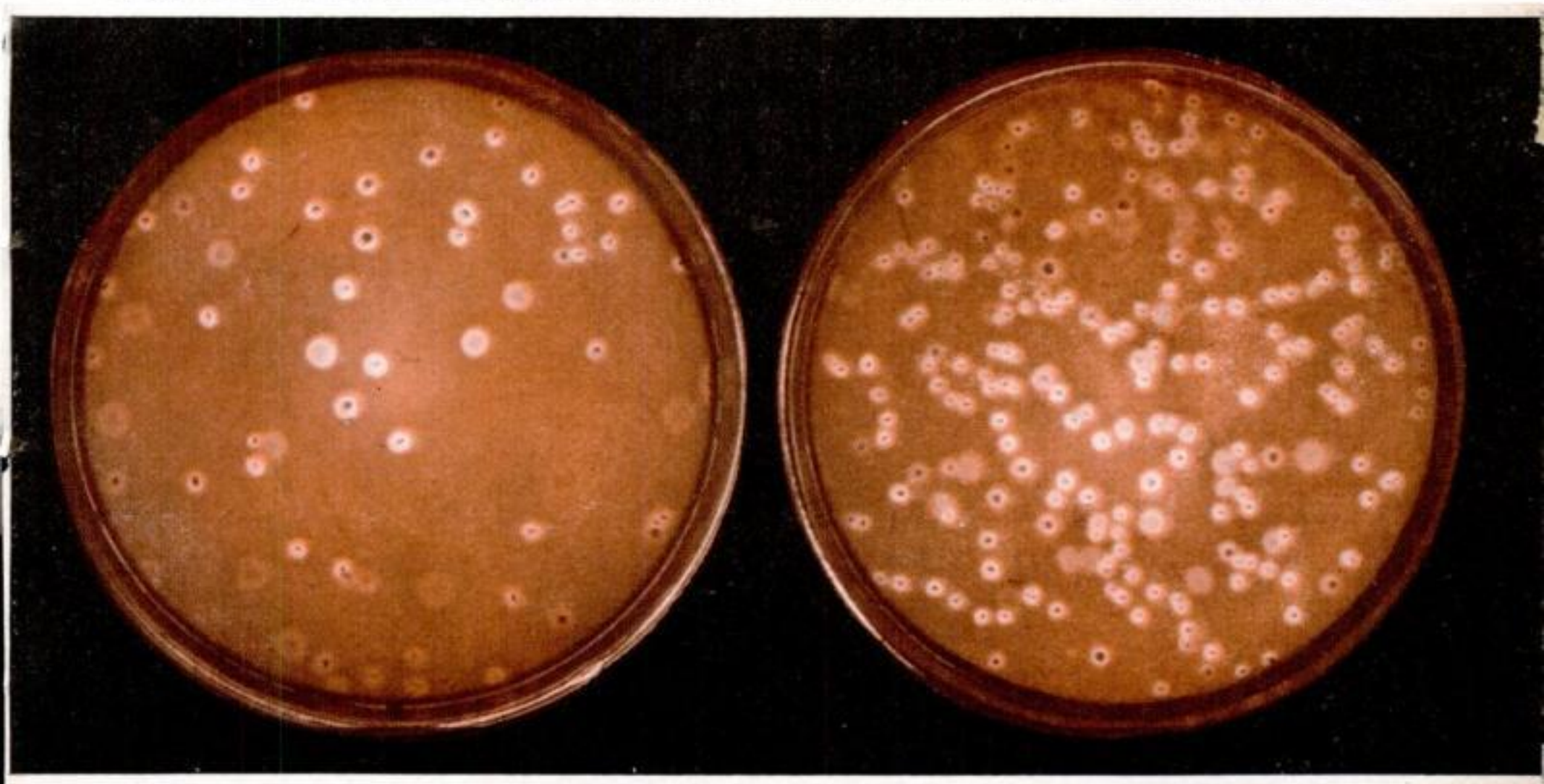
When the death rate from a disease like pneumonia, which attacks some 450,000 people every year in the United States, is

1 HOW SULFA DRUGS "INHIBIT" BACTERIA, shown in photos for the first time. Below, hemolytic streptococci culture treated with sulfadiazine . . . and this is a plain, untreated agar plate containing an equal amount of the bacteria. These photos were made one hour after treatment was made

2 AFTER TWO HOURS, little difference can be observed between the treated plate, below, and the untreated one. The bacteria are increasing in both . . . as indicated by the growing number of white spots, each of which is a colony containing millions of the bacteria that cause infection of wounds



cut to a half or a third, the reduction in human misery and economic loss is enormous. The same holds for less prevalent but more virulent infections like meningitis, which before the advent of sulfa therapy was in its worst forms practically always fatal, and now has a recovery rate ranging between 70 and 90 percent. If this is true under normal conditions, in wartime the value of a medical tool like the sulfa drugs is incalculable. War always opens the way to disease, and disease may do more direct and indirect military damage than all the weapons of the enemy. Even when, as in the case of influenza, sulfa therapy is ineffective, the harm done may be materially reduced. Pneumonia acts as the executioner for influenza, and in one series of 548 pneumonia cases in the U. S. Army last year the death rate under sulfa treatment was 2.1 percent—a figure which bears out Dr. Perrin Long's prediction that prompt administra-



3 AFTER FOUR TO FIVE HOURS, however, there is a noticeable diminution in the number of spots on the treated plate, as the drug gets down to work . . . while the untreated control plate still shows an increase. A 1-10,000 concentration of sulfadiazine in the other plate makes all this difference

4 AFTER 10 TO 12 HOURS, the last of the bacteria colonies in the treated plate are giving up the fight; those in the untreated plate flourish

The pictures are taken from the film "Sulphonamide Therapy" prepared at the New York Hospital and the Sulphonamide Division of Lederle Laboratories, Inc.

tion of sulfa derivatives will eventually eliminate pneumonia as a fatal disease.

In military surgery, new methods of treatment based largely on the use of the sulfa drugs have kept pace with the greater destructiveness of weapons. Every American soldier who enters the field of operations is provided with a box of twelve sulfanilamide tablets to be taken internally to prevent infection should he be wounded. Wounds packed with sulfanilamide powder seldom become infected, and heal faster. Fewer amputations are necessary. The sulfa drugs are equally valuable in the treatment of burns and all kinds of injuries in which the defenses of the body against infection have been broken down.

The chemical make-up of the drugs which produce these astounding results is not too hard to understand in a general way. By this is meant the composition of the tablet in the bottle, not what it does after it is swallowed. The latter is still in the realm of investigation and conflicting theories; we shall have something to say about it later. For the moment we are concerned with the simpler question of what the stuff is.

The first lesson of practical chemistry is never to shy at a long name or formula. Long chemical terms are merely strings of short terms, each of which means something. Take sulfanilamide—*sulf-anil-amide.* Any boy who has fooled around with a chemical set and an elementary textbook may recollect that an *amide* is a compound of something with the radical NH_2, so it is a safe guess that there must be nitrogen and hydrogen in sulfanilamide. *Anil* is obviously related to *aniline,* which is a well-known coal-tar product with the formula $C_6H_5NH_2$. There is that NH_2 again, and more hydrogen, and a significant addition—six atoms of carbon. And *sulf*—that must have something to do with sulphur, as in sulphuric acid, and as in most sulphur compounds, it is probably linked with oxygen. It is, in fact—SO_2, sulphur dioxide.

But when we conclude by this reasoning that sulfanilamide must be composed of nitrogen, hydrogen, carbon, oxygen, and sulphur we must also realize that we know only the first thing about it. Two substances containing the same elements, but in different proportions, may differ vastly in their chemical properties. Alcohols, for instance: C_2H_5OH, and CH_3OH. Each is nothing but carbon, hydrogen, and oxygen, but the apparently minor difference between C_2H_5 and CH_3 makes the first—ethyl alcohol—quite pleasant in moderate amounts to a lot of people, while the second—methyl or wood alcohol—is a violent poison. Or the carbon dioxide of soda water and the deadly carbon monoxide of incomplete combustion.

The clew to the manner in which these very ordinary elements—nitrogen, hydrogen, carbon, oxygen, and sulphur—combine to make the extraordinary compound called sulfanilamide, may be found in its earlier and more fully descriptive name of para-aminobenzene - sulfonamide. The *benzene* part is the keystone of the structure. Chemicals like benzene, toluene, aniline, etc., are called coal-tar intermediates, because industrially they stand between the coal from which they are made and the explosives, dyes, perfumes, and medicines which are made from them. In steel manufacture, for example, coal is partially burned to coke. The gases which are driven off in this process contain the precious coal-tar intermediates. Benzene is the simplest of the lot, and that is why we are starting with it instead of with aniline. Benzene is a hydrocarbon, a compound of hydrogen and carbon, six atoms of each—C_6H_6. Diagrammatically it may be represented as a six-sided ring of carbon atoms, each with its hydrogen outrigger. This is a symbol of modern alchemy. By knocking off one or more hydrogen atoms and replacing them with something else, a variety of compounds of vast importance in peace and war are constructed. For example, getting rid of one of the hydrogen atoms and substituting the hydrocarbon combination CH_3 which we met before in methyl alcohol, we get *methylbenzene,* or *toluene.* If, by treatment with nitric acid, three more hydrogen atoms are detached, we get *trinitrotoluene—tri-nitro-toluene,* or TNT, the leading military explosive. And, having knocked a hole in a man's chest with a shell fragment propelled by TNT, we can heal the wound by packing it with *sulfanilamide,* which is strikingly similar to TNT in molecular architecture and shares some of the latter's constituents.

The similarity in structure is due to the fact that these two compounds, and many others, are built around the six-sided carbon ring, which is called the *benzene ring* and forms the basis of coal-tar chemistry. It occurs so frequently that chemists usually omit the C and H labels and just draw a hexagon.

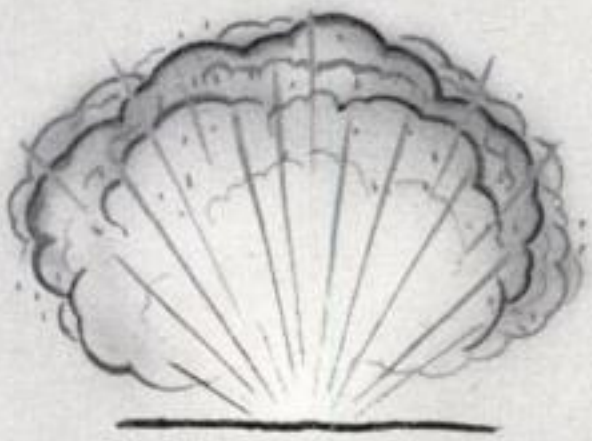
But the process of synthesis and transmutation does not stop with sulfanilamide; it only begins there. Sulfanilamide is the

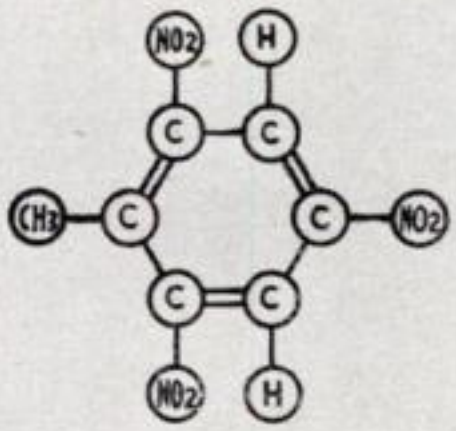
Molecule models show how, by adding an atom or combination of atoms to the paraaminobenzenesulfonamido group, we get each of the five different drugs of the sulfa family

SULFA-DRUG CHEMISTRY

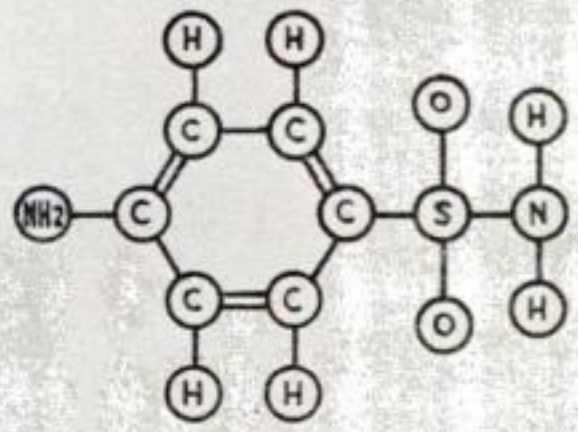
In molecular structure, Sulfanilamide is strikingly similar to TNT and it shares some of the latter's constituents. This similarity is due to the fact that both are based on the six-sided carbon ring called the benzene ring.

TNT

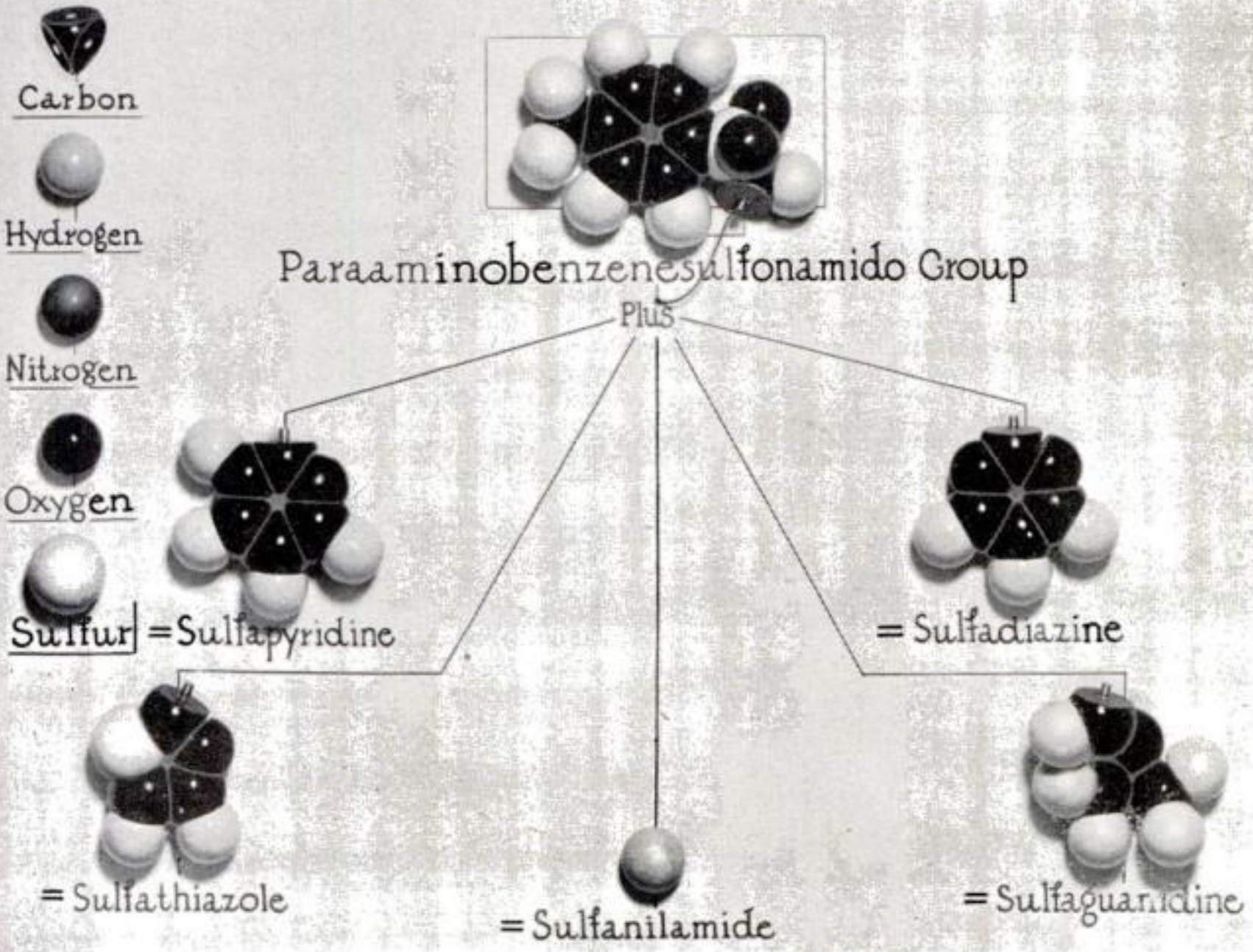




SULFANILAMIDE



HOW THE FIVE SULFA-DRUGS ARE FORMED



most familiar, but some of the other sulfa drugs are even more useful to mankind. They are made in the same way—by detaching a hydrogen atom at one end of the atomic structure and substituting for it a subsidiary structure. Thus sulfanilamide itself was not found highly effective in the treatment of pneumonia, but the British made up another compound, sulfapyridine, which gave much better results.

The trouble with sulfapyridine was that in many cases it caused nausea which compelled discontinuance of the treatment. Sulfathiazole and sulfadiazine were synthesized to slow up the action and overcome this defect. Sulfadiazine is the least toxic of the sulfa drugs so far evolved, and is likely to be the most widely used until something better comes along.

A recent addition to the family, sulfaguanidine, is absorbed largely in the intestinal tract and hence is peculiarly suitable for treatment of intestinal diseases like dysentery. The new drug involves a relatively small addition to the sulfanilamide structure.

Over 2,000 sulfa derivatives have already been synthesized and there is no obvious limit to the number that can be added in the future. The chances of any particular new compound proving extraordinarily successful may be small, but there is always the possibility that the next one will turn out to be fatal to some breed of microbes hitherto invulnerable. Actually this is more than a possibility, for these chemical operations are much more than a random throwing together of atoms.

The development of the sulfa drugs, on the chemical side, is neat and scientific and well planned, but it did not start that way. Sulfa therapy resembles another far-reaching medical technique—the X ray—in that its origin was non-medical. But there is also a difference: the X ray was seized on by the medical profession within a few months after its appearance, while the curative qualities of sulfanilamide remained unsuspected for more than 20 years.

Back in 1906 a student named Gelmo was majoring in chemistry at the Vienna Institute of Technology. To get along in chemistry a German, then as now, had to be a doctor of something or other. To become a doctor he had to write a thesis. To write the thesis he had to do a piece of more or less original research.

The student Gelmo chose as his research project the synthesization from coal tar of a new chemical compound. There were already hundreds of coal-tar derivatives. Some were useful; some simply cluttered up the textbooks. Gelmo added one more. He called it para-aminobenzene-sulfonamide.

When Gelmo's dissertation appeared in 1908 it was duly read by the staff of the great German chemical trust, I. G. Farbenindustrie. The diligent technicians of this far-flung organization scanned every page of every chemical publication as a matter of routine, and tried out every new compound on the chance that it might be of some use to the trust—and the German Empire. They found a modest utility in Gelmo's modest creation. Colorless itself, it made some of their dyes faster for washing and milling. As far as anyone knew, that was all the stuff was good for.

There was some bad luck involved here. Ehrlich, the godfather of modern chemotherapy, was plugging along through his 606 experiments toward Salvarsan at the time. Moreover, some of his tests were with coal-tar dyes. If he had chanced on sulfanilamide, the medical pay-off would have come then. But he did not come across it, or, if he did, failed to recognize its potentialities.

In 1919 there was more bad luck, this time on our side of the Atlantic. The bactericidal properties of certain compounds, including sulfanilamide, were referred to in passing by two Rockefeller Institute chemists in an article in the Journal of the American Chemical Society. They promised a further report by a medical colleague. The report never appeared. Had this lead been followed, some 14 years and hundreds of thousands or millions of lives might have been saved.

In the end, the I. G. chemists got the glory after all. In the 1930's they set out on a search for a concoction to kill bacteria in the bodies of animals and human beings. They finally patented a proprietary preparation to which they gave the trade name *Prontosil*. Small quantities were distributed among a few Rhineland physicians, and, early in 1933, while the triumphant Nazis were in the preparatory stages of their career of plunder and conquest, remarkable events of another kind were being reported in the German medical press. Desperately sick people who, by all the rules, should have been dying of blood poisoning and other infections, were recovering miraculously under treatment with Prontosil.

After the usual period of indifference and skepticism, the outside world took notice. The French made *(Continued on page 212)*

The new gun compared with the Garand: Weight — 4½ lbs. less

LIGHTWEIGHT CARBINE

INCREASES ARMY'S FIRE POWER

By PETE KUHLHOFF

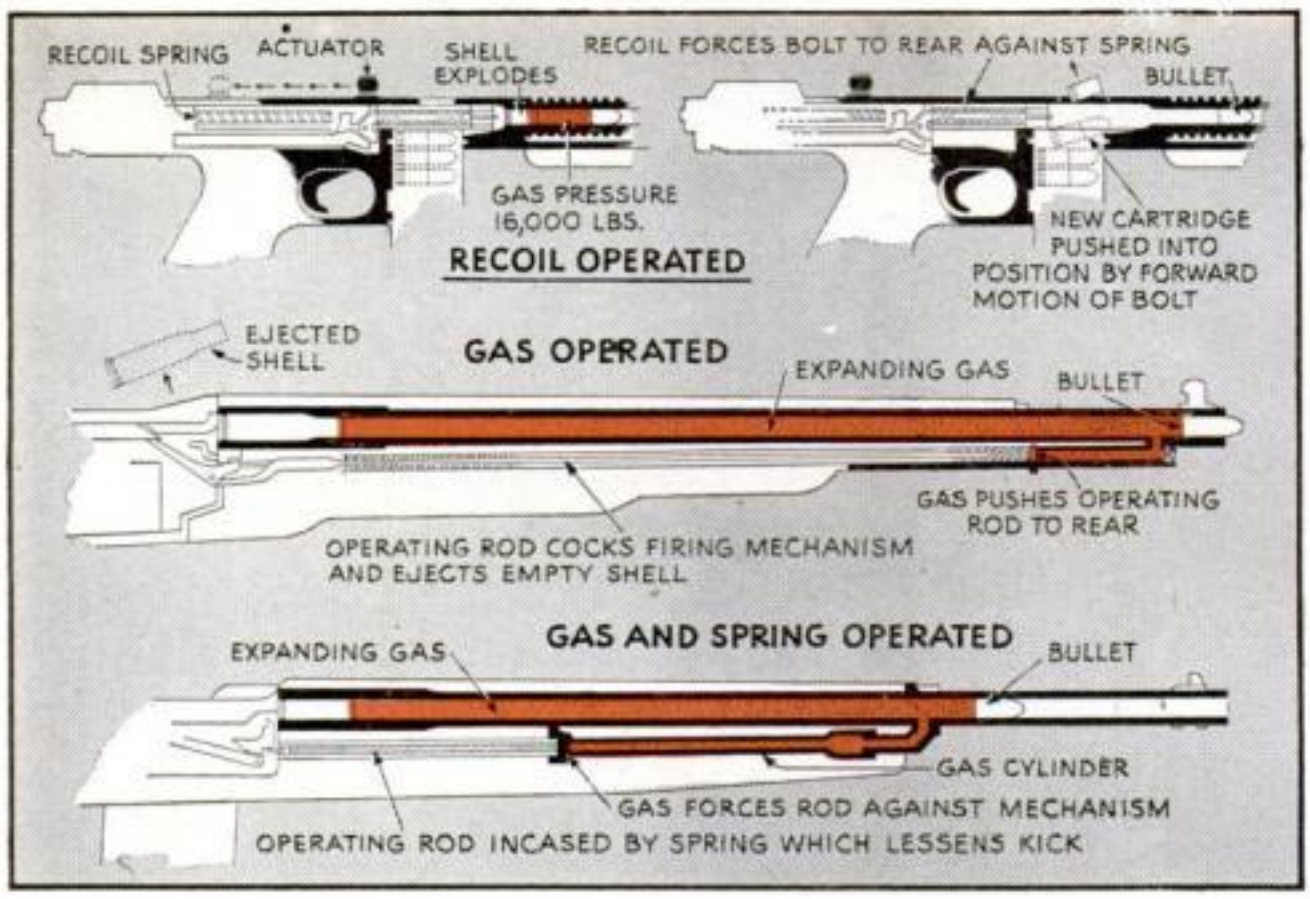
UNCLE SAM is arming many of his soldiers with a new gun. Officially tagged U. S. Carbine Caliber .30 M-1, it is at present in production and will no doubt be with troops by the time you read this. The new light gun will replace about 80 percent of the .45 caliber automatic (self-loading) pistols now being used in the service.

Present-day so-called "blitz" warfare is nothing more than a modernized version of cavalry tactics worked out many years ago —the idea being to get at an ememy's weak point with a superior force.

In this type of warfare, utilizing modern, fast equipment such as tanks and planes, the combat zone may be fifty, 100, or even 200 miles deep as compared with the several hundred yard zone of trench warfare as we saw it in World War I. Consequently, artillerymen, motorcyclists, ammunition carriers, and other soldiers whose personal arms are of secondary importance must be equipped with means of entering into deadly struggle at any time.

Now, the .45 automatic pistol, besides

Details of the .30 caliber M-1 carbine. The yardstick shows it's 7½ inches shorter than the Garand



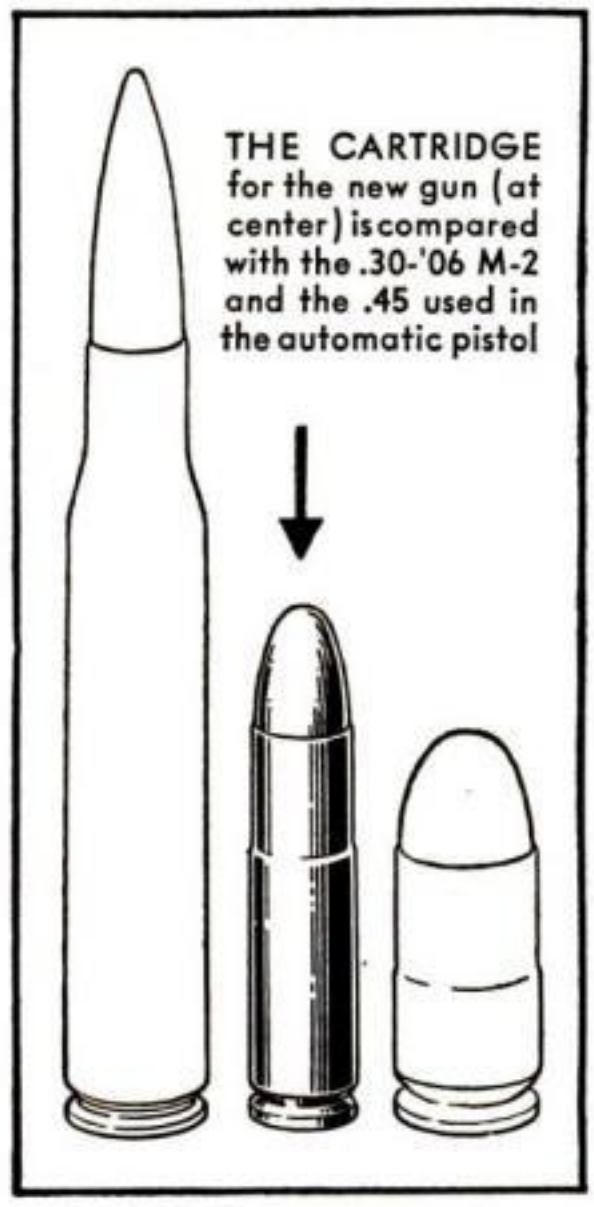
Three types of operation used in military rifles. The carbine employs the gas-and-spring system, in which gas ejects the used shell while a spring chambers the live cartridge

being the most difficult of all weapons to master, is just not enough gun for this purpose. So the War Department decided to adopt a weapon light enough to be carried by such troops so they would not be unnecessarily burdened in the execution of their normal duties—and yet be able to develop effective fire power at several hundred yards.

Specifications were drawn up, calling for a five-pound semi-automatic rifle chambered for a new light but powerful .30 or .32. caliber cartridge, equipped with a 20-round magazine and light carrying sling; the gun to be as simple and reliable as possible, easily operated by hand if necessary, and as accurate as the regular service rifle up to at least 300 yards.

When the initial test board convened, several pilot models were submitted by various companies and individual designers. As the testing for accuracy, sustained firing, and exposure progressed, one gun stood out above all the rest. It took more abuse, held up longer under sustained firing, and had fewer broken parts.

This gun, which was submitted by the Winchester Repeating Arms Company, is something entirely new and different as far as the U. S. Army is concerned. It is 7½ inches shorter and weighs only about half as much as the Army's full-power Garand semiautomatic rifle. It tips the scale at around 4½ pounds. The magazine holds 15 rounds of a new cartridge which has a .30 caliber, 110-grain bullet seated in a straight rimless case. It is loaded with a smokeless-powder charge to develop about 40,000 pounds pressure per square inch which pushes the bullet at 2,000 feet a second at the muzzle.



The extracting, loading, and locking mechanism is gas-and-spring operated. Gas from the fired cartridge opens the breech mechanism, cocks the firing pin, and tosses out the empty case. Immediately a recoil spring closes the action, which automatically chambers a live cartridge.

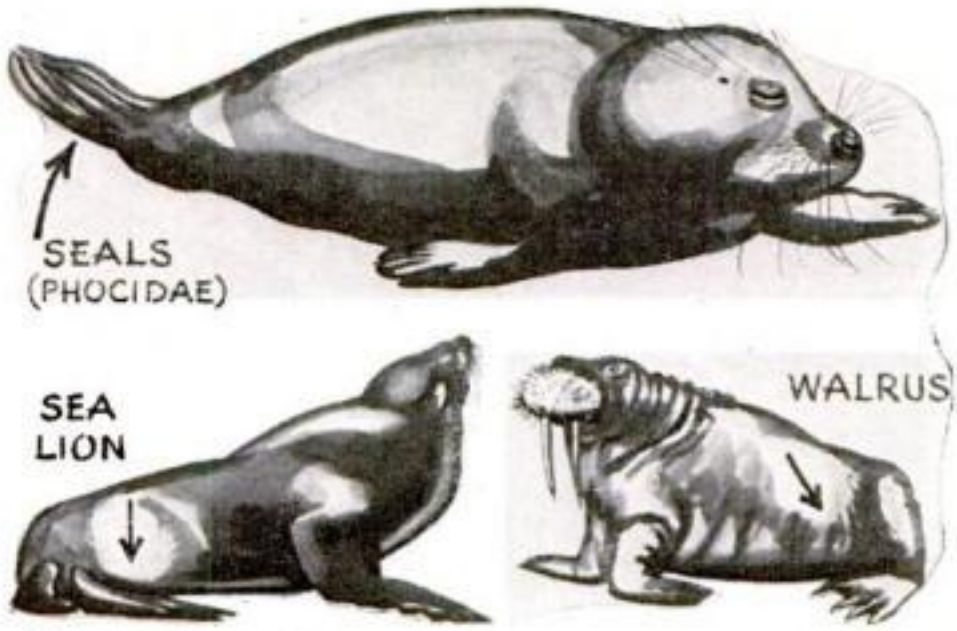
In the design of the new lightweight weapon, the Winchester engineers took advantage of the fact that gas drawn off close to the chamber before cooling can take place prevents carbonization of a weapon's piston and gas port. This feature eliminates considerable trouble in the field and the necessity of frequent carbon scraping.

The new-type carrying sling permits the gun to be carried slantwise across the back, leaving both hands free.

Army experts estimate that adoption of the new weapon will increase offensive fire power a full 33 percent. This is based on the theory that volume is more effective than accuracy on the battlefield. But, certainly, all shots fired from these little rifles will be several times more accurate than those discharged from the .45 caliber pistol formerly used for the same purposes.

Un-Natural History

BY Gus Mager

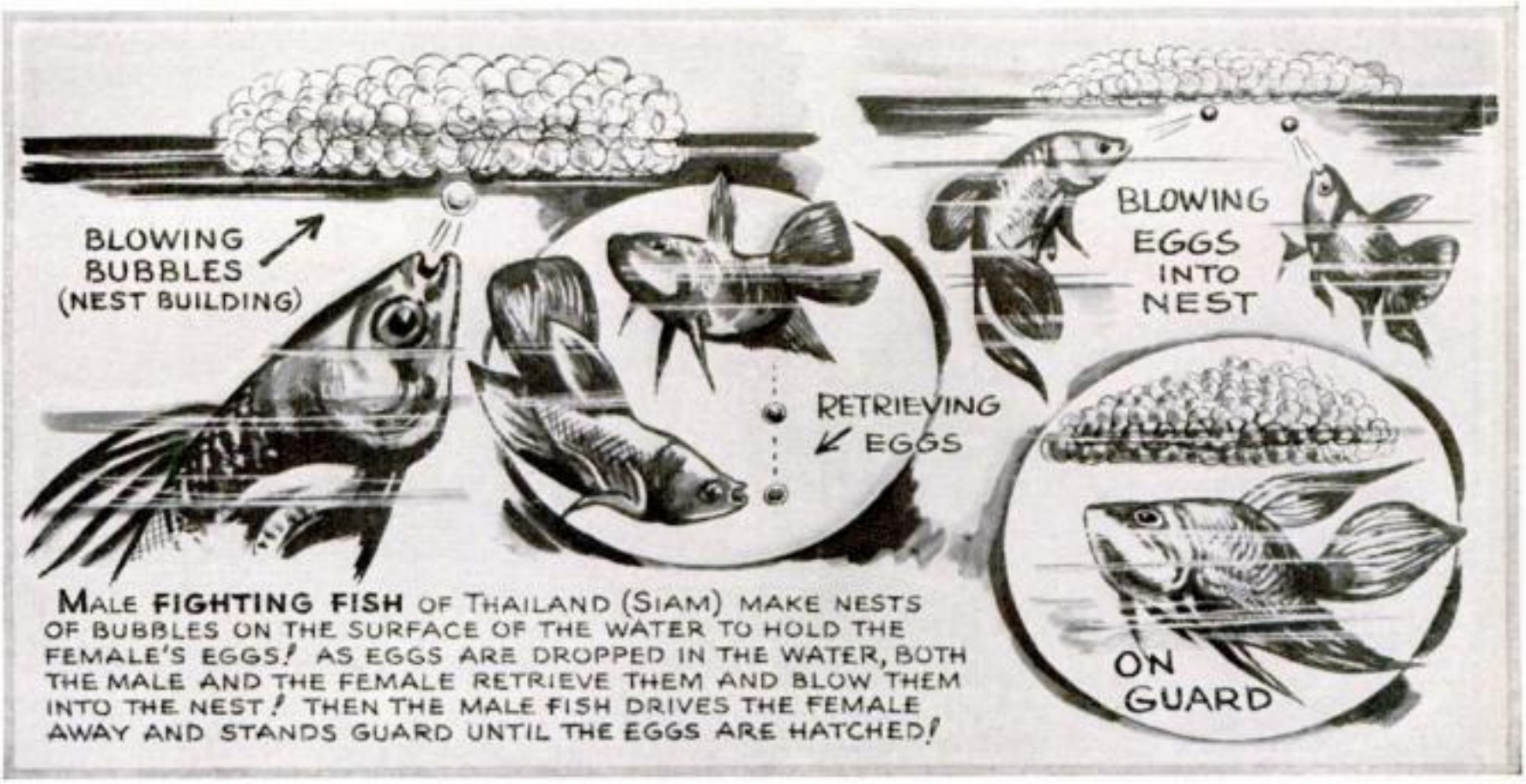


THE TRUE **SEAL** HAS NO EXTERNAL EARS, AND ITS TAIL IS DIRECTED STRAIGHT BACK AS A RUDDER! BUT **EARED SEALS**, INCLUDING THE **SEA LION**, HAVE EARS AND HIND FLIPPERS THAT TURN FORWARD, WHILE THE **WALRUS** HAS NO EXTERNAL EARS BUT HAS FLIPPERS LIKE THE SEA LION'S!

EVERY **BEE** COLONY HAS A DISTINCTIVE ODOR, SO THAT SENTINELS ON GUARD CAN RECOGNIZE INVADERS OR ALIEN FIFTH COLUMNISTS BY THEIR SMELL AND MAKE SHORT WORK OF THEM WITH THEIR STINGS!

EVERY ONCE IN A WHILE A MOTHER **TRAP-DOOR SPIDER** WILL SNAP UP ONE OF HER YOUNG AND CRUSH IT BETWEEN HER JAWS, SO THAT THE OTHER MEMBERS OF HER LARGE FAMILY MAY PARTAKE OF THE JUICES OF THEIR LITTLE BROTHER OR SISTER!

OUR **PINE SNAKE** SWALLOWS EGGS WHOLE! THAT IS, THEY GO DOWN ABOUT EIGHT INCHES BEFORE MUSCULAR PRESSURE BREAKS THE SHELL, THEN EGG AND SHELL FRAGMENTS GO ON DOWN THE HATCH TOGETHER!



MALE **FIGHTING FISH** OF THAILAND (SIAM) MAKE NESTS OF BUBBLES ON THE SURFACE OF THE WATER TO HOLD THE FEMALE'S EGGS! AS EGGS ARE DROPPED IN THE WATER, BOTH THE MALE AND THE FEMALE RETRIEVE THEM AND BLOW THEM INTO THE NEST! THEN THE MALE FISH DRIVES THE FEMALE AWAY AND STANDS GUARD UNTIL THE EGGS ARE HATCHED!

HOW IT IS DONE

How to Handle a Rope

A CHAMPION GIVES YOU A LESSON WITH THE LARIAT

By TOM ROAN

THE use of rope as a catcher goes back to the days when primitive man spread vine loops and crude grass ropes to snare animals for his food. But it took the American cowboy to become an artist with a rope. In long days in the saddle, drifting lazily with a trail herd, or hours alone during the night herding, the rope became his plaything. The comparatively simple routine of roping a horse, calf, or steer was not enough. He worked out new tricks. Step by step he progressed, until today the American cowboy is the wizard of the lariat.

To bring the fundamentals of roping to our readers we found a champion in D. H. Frank Biron, now operating the Cowtown Guest Ranch near Ramsey, N. J. Biron is an all-around "cow hand"—bronco buster, trick rider, wild-steer bulldogger. As a trick-rider and trick-roper champion he has his picture in the cowboy halls of fame from coast to coast.

Frank Biron has as many ropes as a Texas wildcat has fleas, but let us take you up the gentle stages by beginning with 25 feet of cotton rope known as spot cord No. 12 (⅜ inch) that can be purchased through any western supply store for from 7½ to 12 cents a foot.

Trim the end of the rope with a sharp knife so that it will fit snugly and smoothly when the bend is made. Double the trimmed end back to make an oval about 2½ inches long, inside measurement. A heavy waxed harness thread is then drawn through and wrapped tightly to make the trimmed end of the rope firm and strong. Light copper or rustproof wire may be added to make the rope slightly heavier. In finishing the honda, as this loop is called, a second wrapping must be made around the tip to give it balance and retain the oval shape. This is important, for balance as well as to keep the honda from "choking" the rope afterwards to be threaded through it.

When your rope is ready, make a noose as shown on page 85. The spoke—the length of the rope that passes through the honda to the hand—is the part you hold when you cast your loop, and must be one third of the loop you intend to cast. Note carefully the finger position. The loop is held by the first and second fingers while the thumb and two remaining fingers remain on the spoke.

As the loop widens in spinning, the spoke slips gradually, taking up the free rope. As there is no swivel on this lariat, the rope must turn in the hand, and when the end of the free rope is reached it must not be held tightly in the hand, or it will start to wabble, curl, and kink. To help yourself along, wrap the end of the rope with smooth wire or waxed string to form a ball so that it will turn easily in your hand when all the rope but the spoke is out in the spinning loop.

(CONTINUED)

1 BUILDING YOUR ROPE. Start with 25 feet of No. 12 spot cord, tightly woven cotton rope. You can buy it from any good western supply store

2 Trim the end at an angle so it will fit snugly against the other side when the bend is made. Rope is ⅜ inch thick, costs 7½ to 12 cents a foot

Texas Skip is demonstrated at right by Frank Biron. To do this popular trick, build a large loop as shown below and get it into a vertical counter-clockwise spin. When it is well balanced and large enough, pull it sharply toward the body and jump through it, continuing the spin on the other side. Jump back the other way

Fig. 1

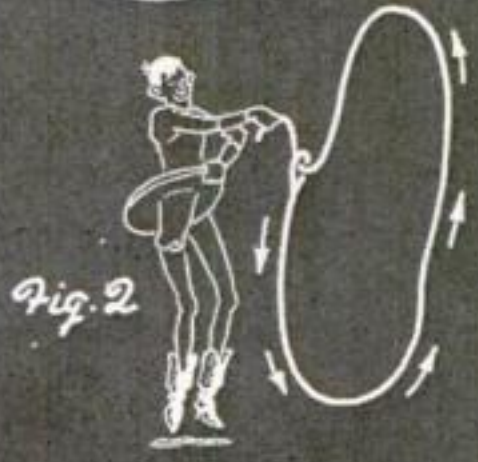


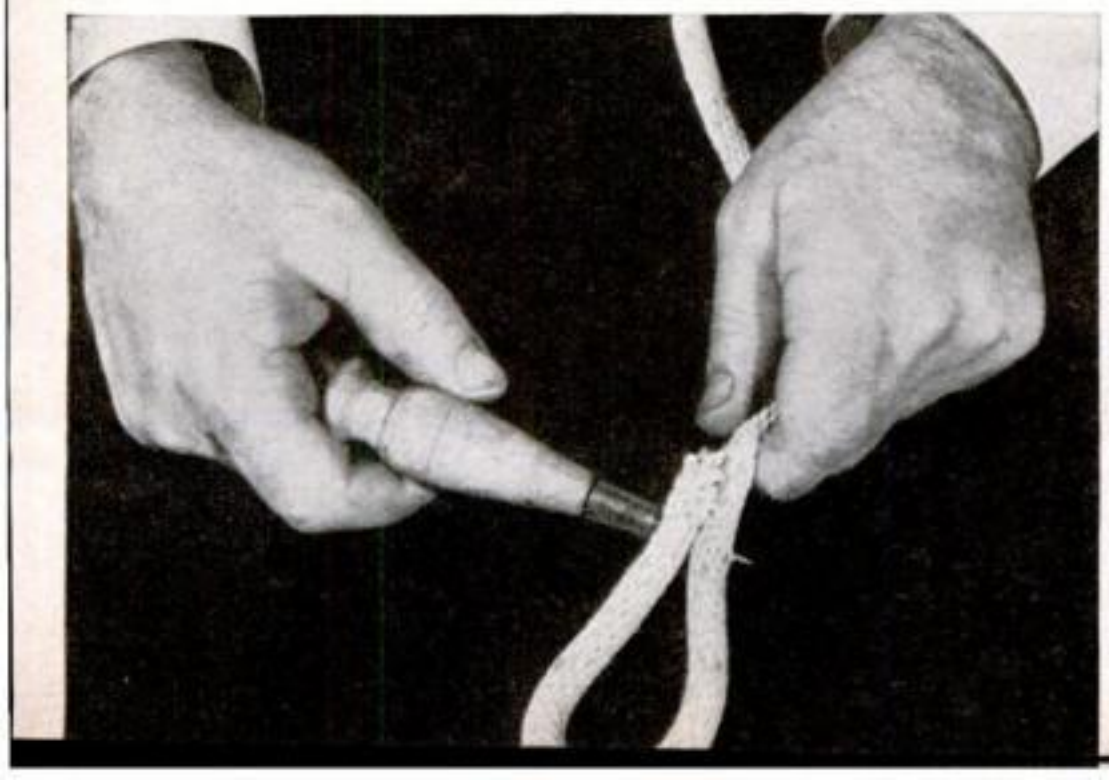
Fig. 2

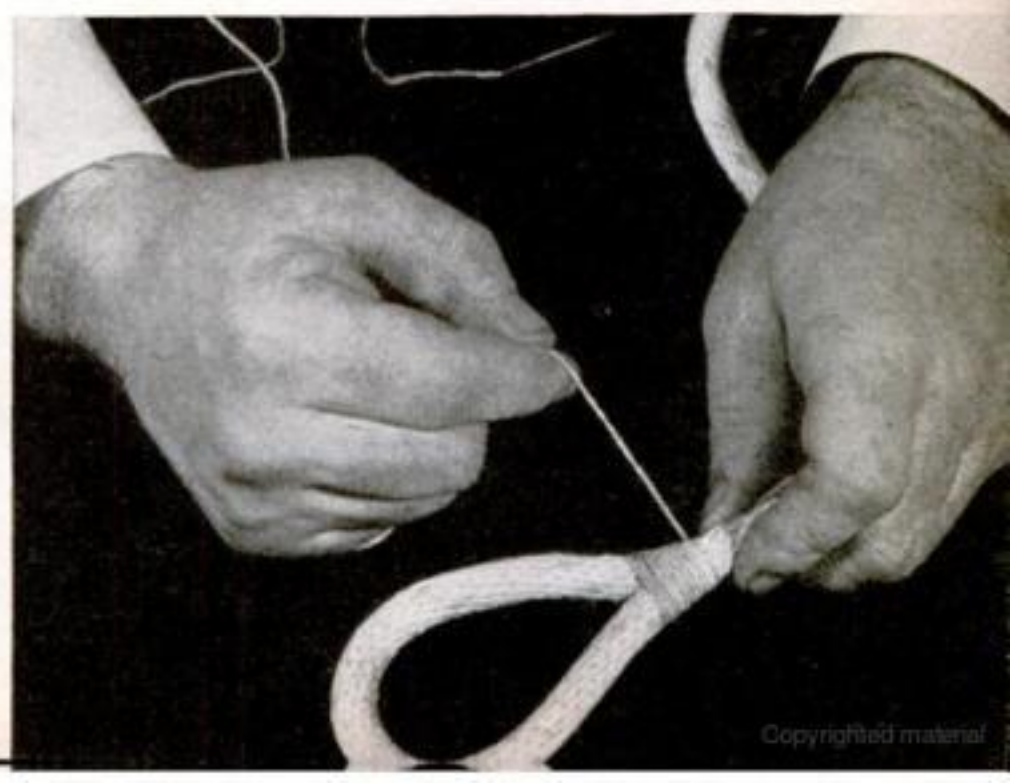
Fig. 3

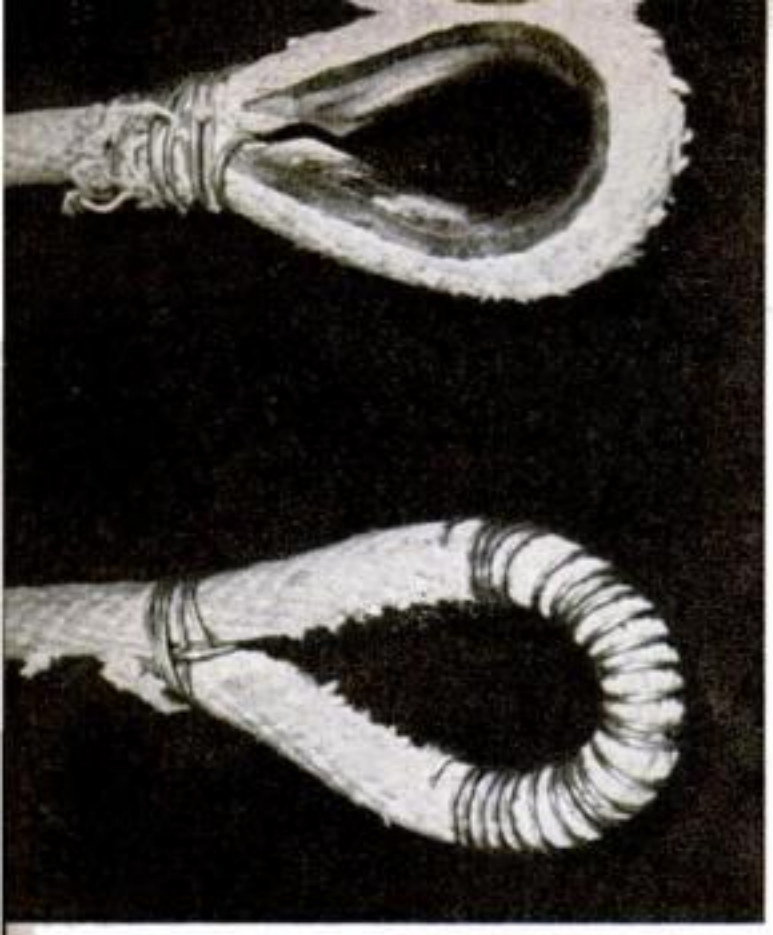
Photos by ROBERT SMITH

3 The end of the rope is now doubled back about 2½ inches to form a natural loop, and an awl is forced through it to make a hole for threading

4 Draw a heavy waxed harness thread (or a light copper wire) through the hole and wrap tightly around the beveled end to form the honda, or loop





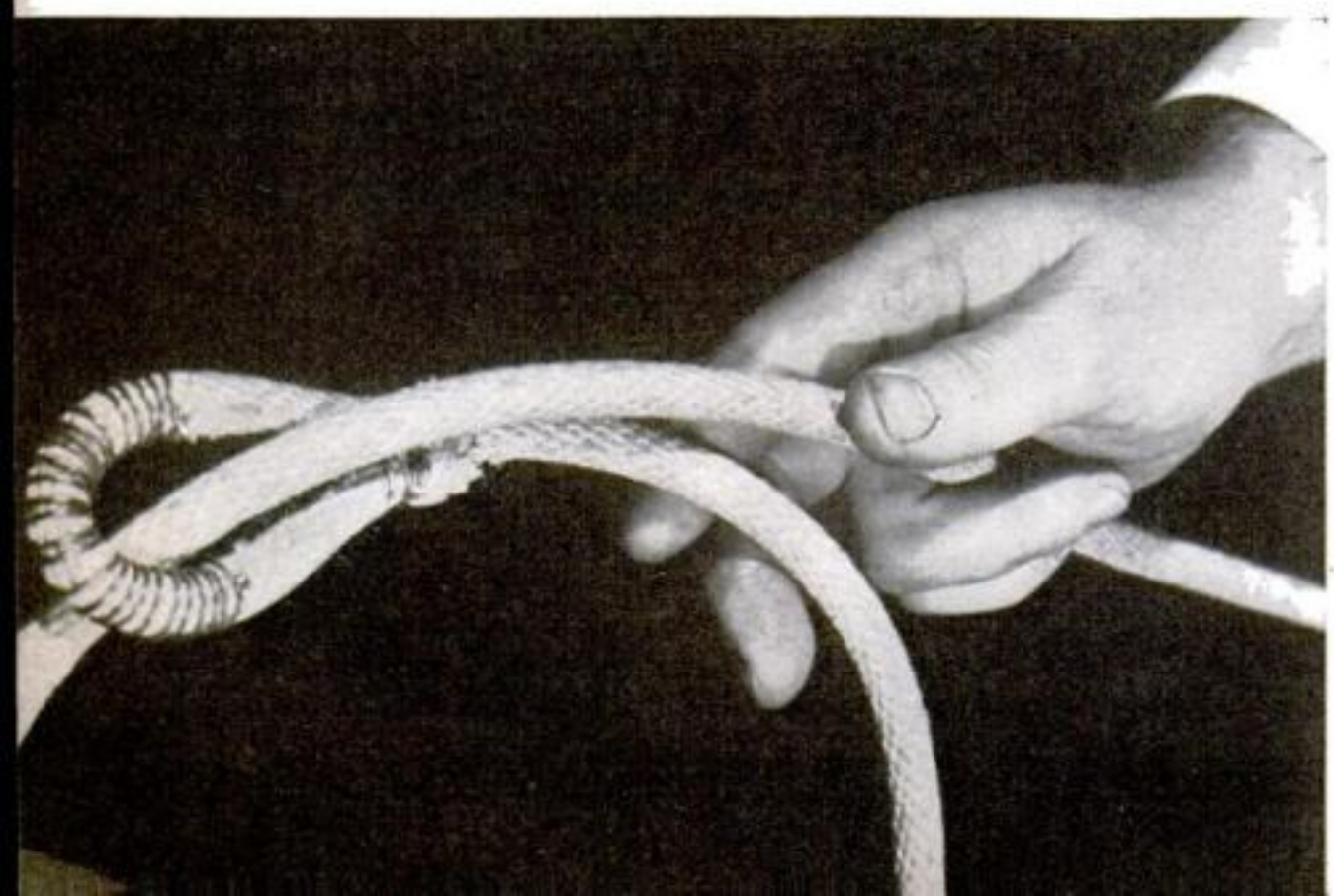


A STEEL GROMMET in the honda at top gives it extra weight. Lower honda has wire wrapped around its tip. Some kind of wrapping is necessary in all hondas to give balance and to spread out the bend

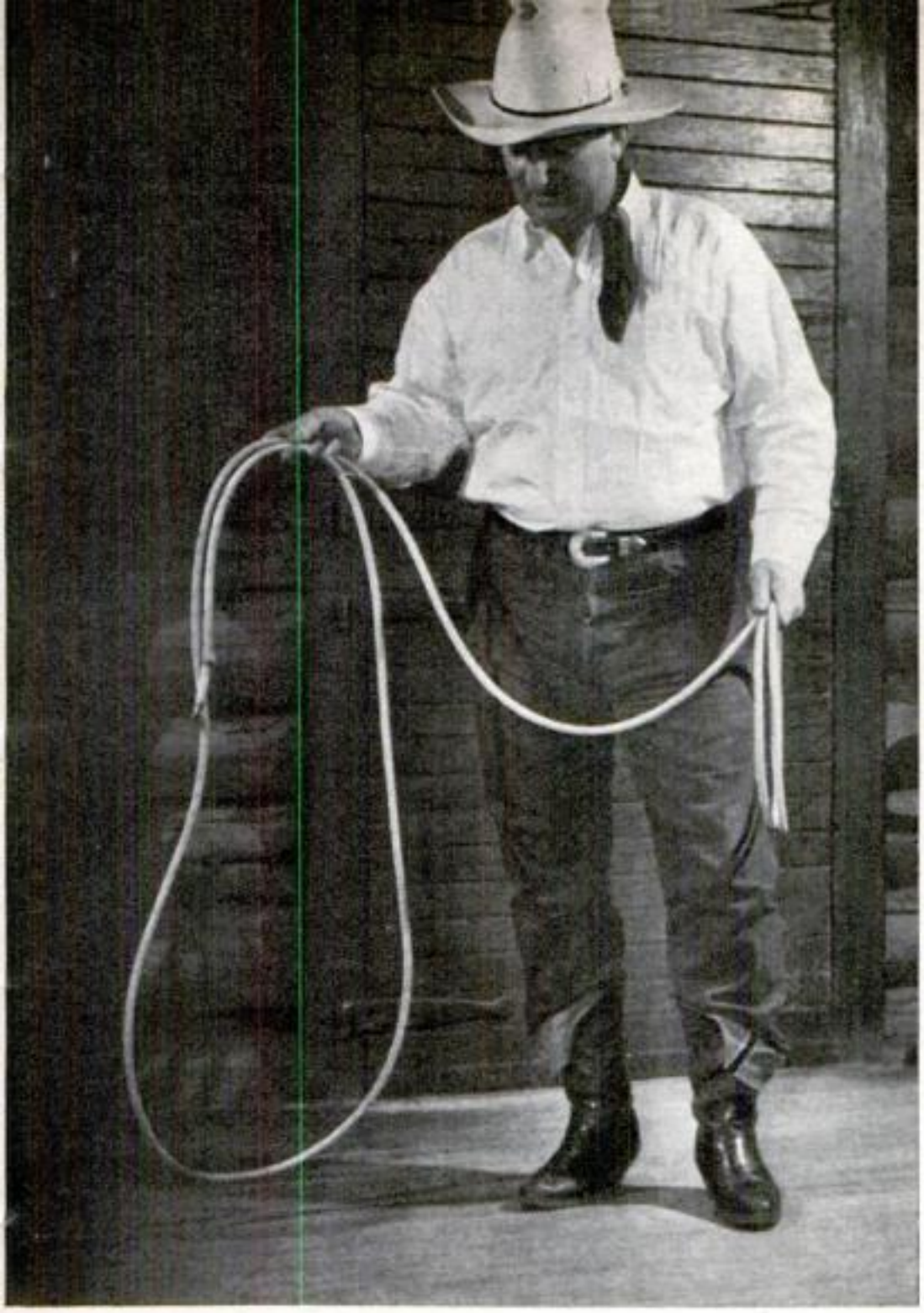
MAGUEY ROPE (pronounced magay) made from the Mexican maguey plant is used by professionals for fancy horse roping. Made under water, they become stiff as steel cables and require expert handling

HONDAS on maguey ropes are delicately made, with braided joints and rawhide swivels. A rawhide balance is also put on the tip of the loop and made rough with a knife so the rope won't slip too fast

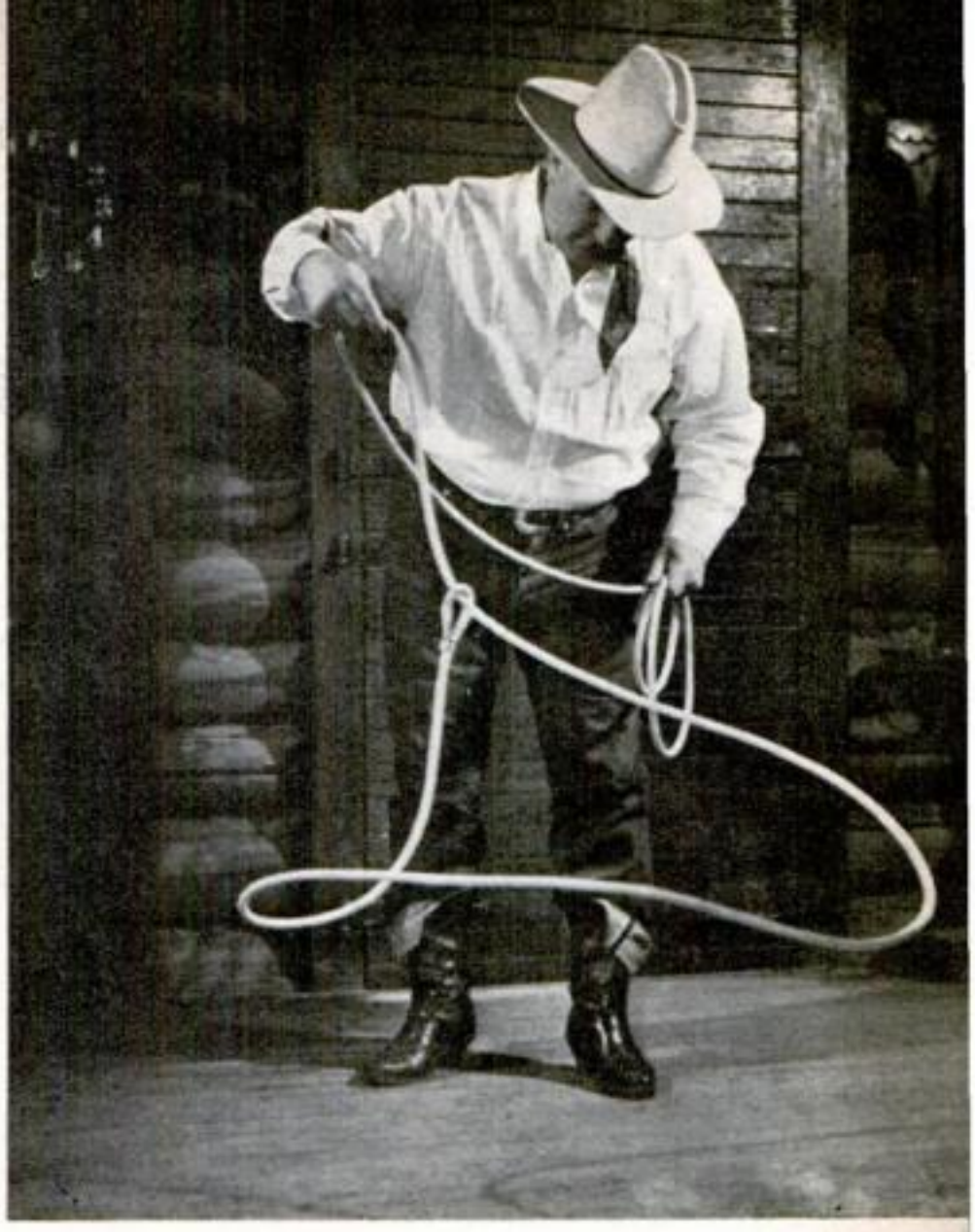
To make a swivel fitting, a piece of rawhide (at top, above) is soaked in water and placed on a mold (left) to harden. When it is tough as bone, it is removed and sewed on the swivel of the honda



HOLDING THE ROPE. For spinning, the loop is held by the first and second fingers, and the spoke (the length that passes through the honda to the hand) by the thumb and two remaining fingers. In the photograph, the spoke is shortened to illustrate the holding position, but in actual spinning it must always be one third of the length of the loop. This finger arrangement makes it easy to drop the loop after it has once been put into motion



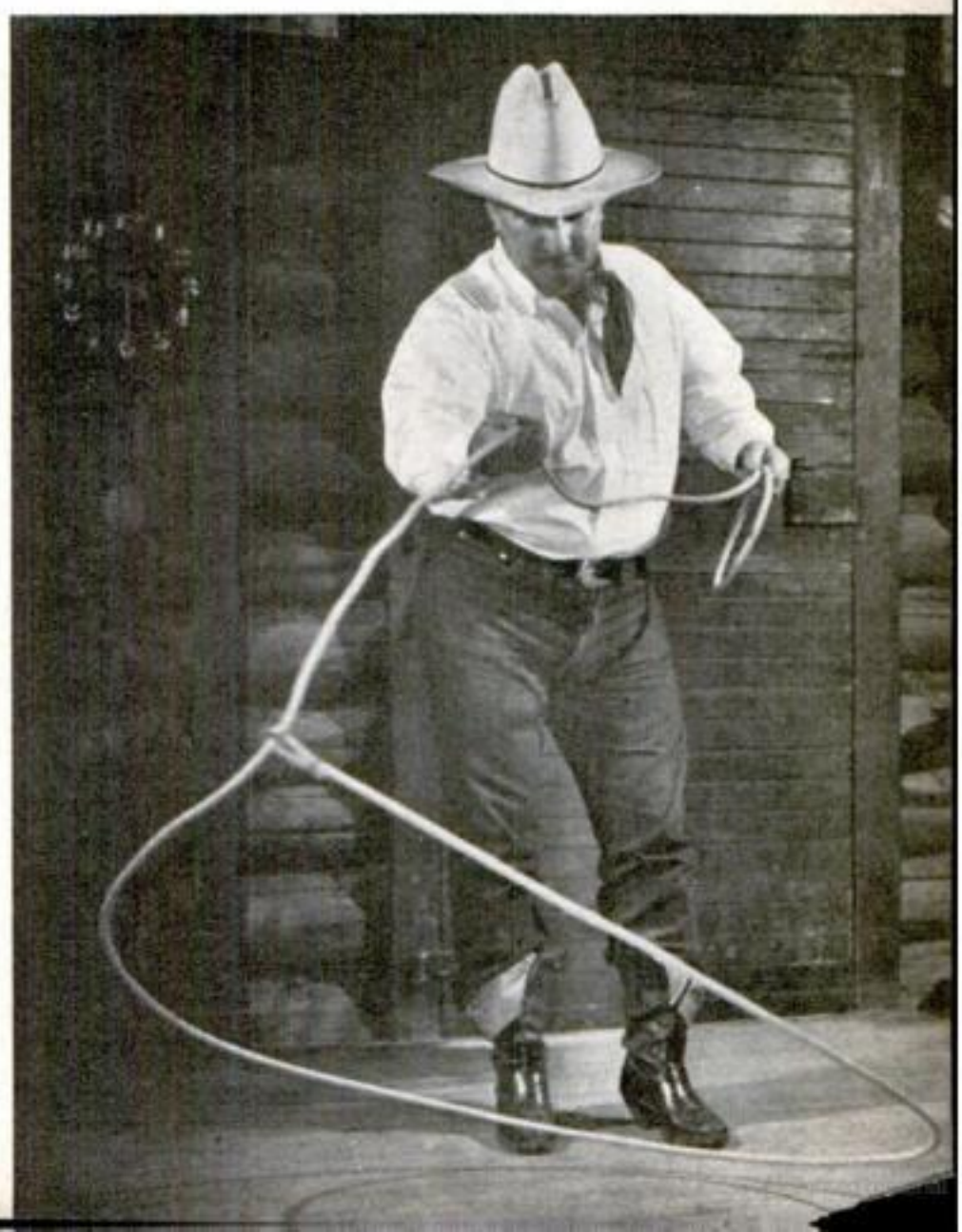
STANCE. These pictures show you how to start the spin. A beginner should start his loop about three feet in diameter, with the spoke in proportion. Loop and spoke are held as shown on the opposite page. Other end of rope is coiled in the left hand



START by putting the loop into motion in the clockwise direction. Drop the loop immediately, retaining the spoke in the hand. A sharp push in the rotary motion and a slight increase in speed will automatically make the loop larger

Patience is required now. Make a ring-like movement of the rope as if trying to spread it on the ground in front of you. Don't jerk it. Don't fling it. Too much speed is the fault of every beginner. You may not make it the first time. The rope will probably come flapping back against your legs. Making certain all the kinks are out of the rope, start with the thought that you are about to swing the loop around a low tub in front of you. As you swing, you let go the loop. The right hand, still holding the spoke, of course, follows the loop around and around. Don't try to keep it circling as wide as the loop. You will find after a few attempts that it is a rotary motion of the wrist that keeps the rope going. Once the loop is established and in a spin, gradually increase the speed of the right hand to widen it. Because it is more natural for the right hand to swing counterclockwise, many people find it easier to start their first loops in that direction. Start the way you find your hand most supple. (CONTINUED)

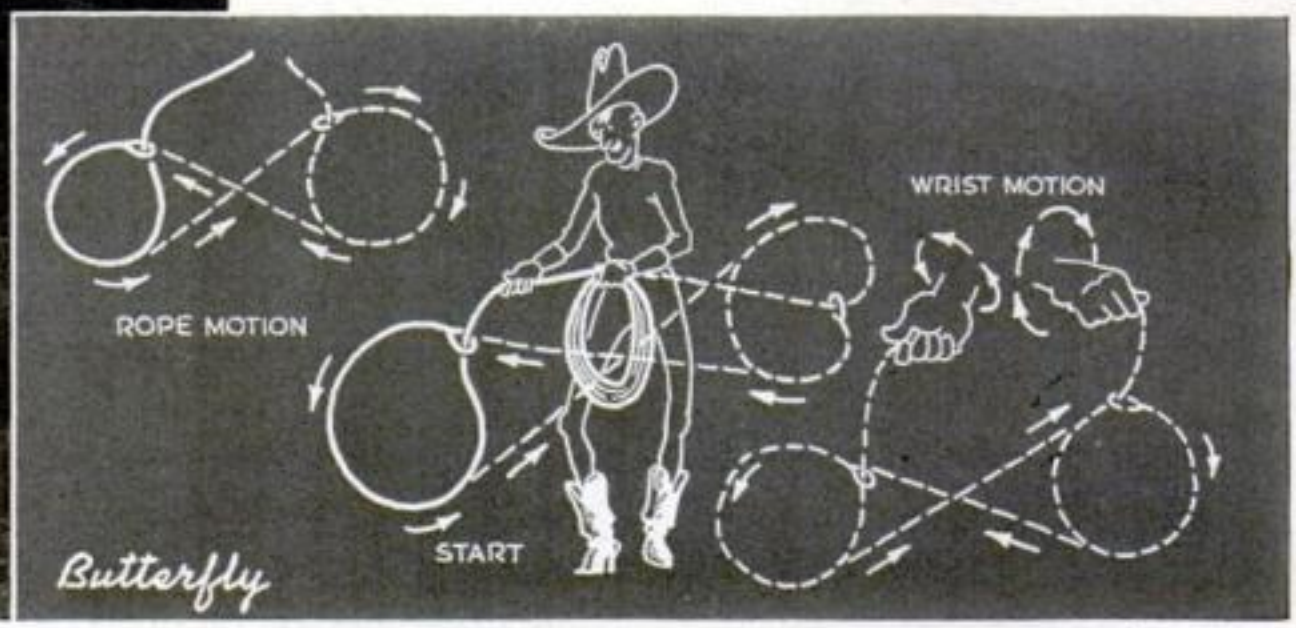
IN SPINNING, an even, rotary motion must be maintained to keep the loop from closing. Since the rope kinks easily, tricks should be learned in pairs so that the kinks put in by one trick will be removed by the following one



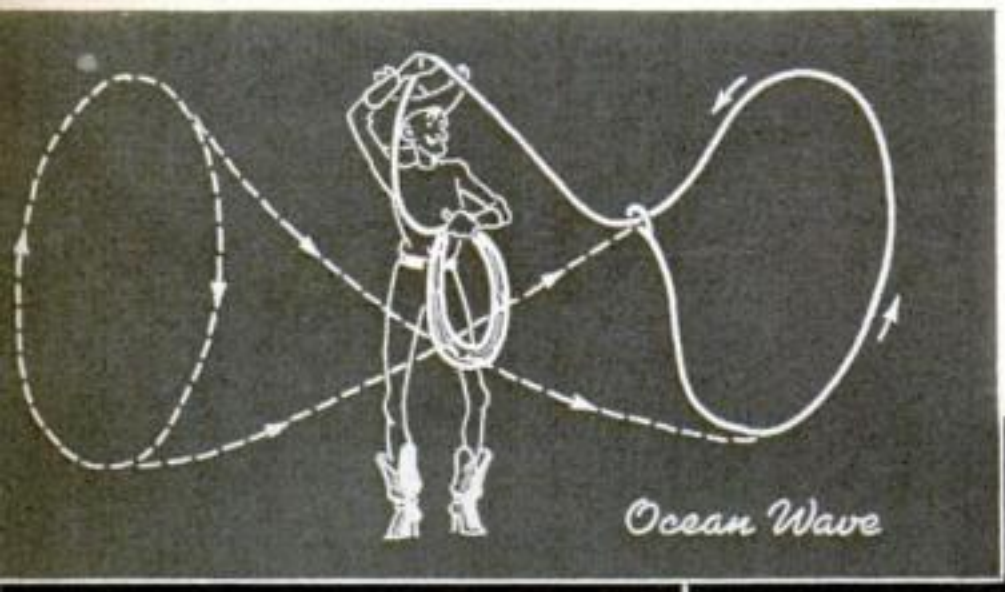
Your next step is to get your loop large enough to step into it. Watch your spoke. See that the loop is spinning evenly. As the spoke comes to you, give your hand a slightly harder twirl. As the spoke passes your feet, step into the loop with the right hand going up above your head to keep up the rotating movement of the wrist.

When you have gone this far you are on your way. Some of the fear of the loop is gone. You are not afraid it is going haywire each time you swing a loop in front of you.

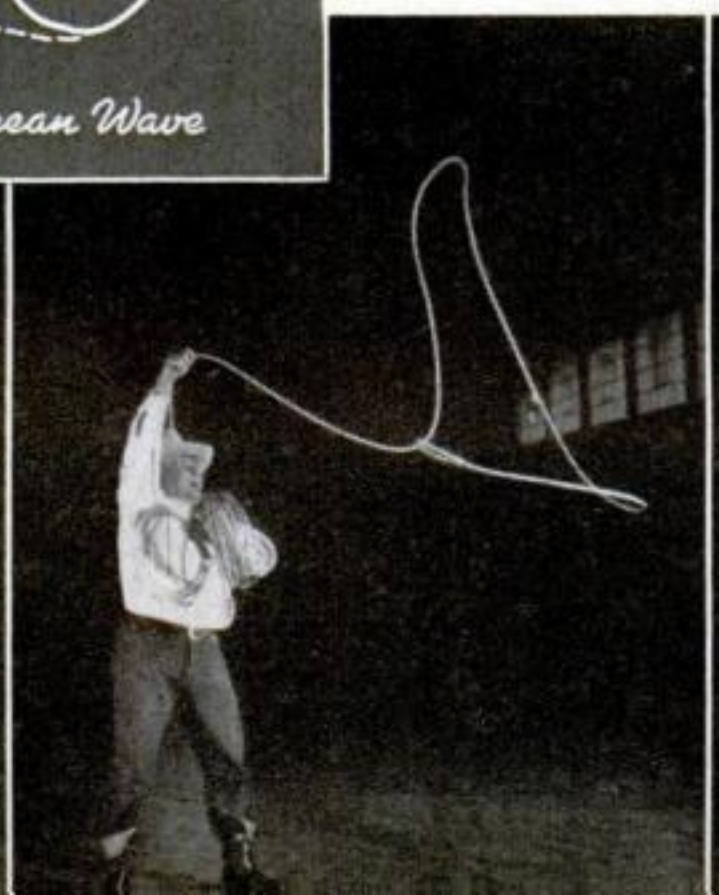
You are at a point now where you can



BUTTERFLY. The object of this trick is to carry a vertical loop across from the right side of the body to the left without stopping the rotary motion. First build a three-foot loop as shown on the preceding page and get it to spinning vertically . . . . . then carry it over from one side of the body to the other, using a figure-eight motion, as illustrated in the drawing above. The change of direction as the rope passes from one side to the other keeps it from becoming kinked during this trick



OCEAN WAVE. By reversing the technique used in the Butterfly and enlarging the loop, you carry a large loop around the body in a vertical position, using the same figure-eight motion. The constant dipping gives this trick the characteristic wavy effect from which it gets its name. This is a popular stunt with the trick ropers in rodeo shows

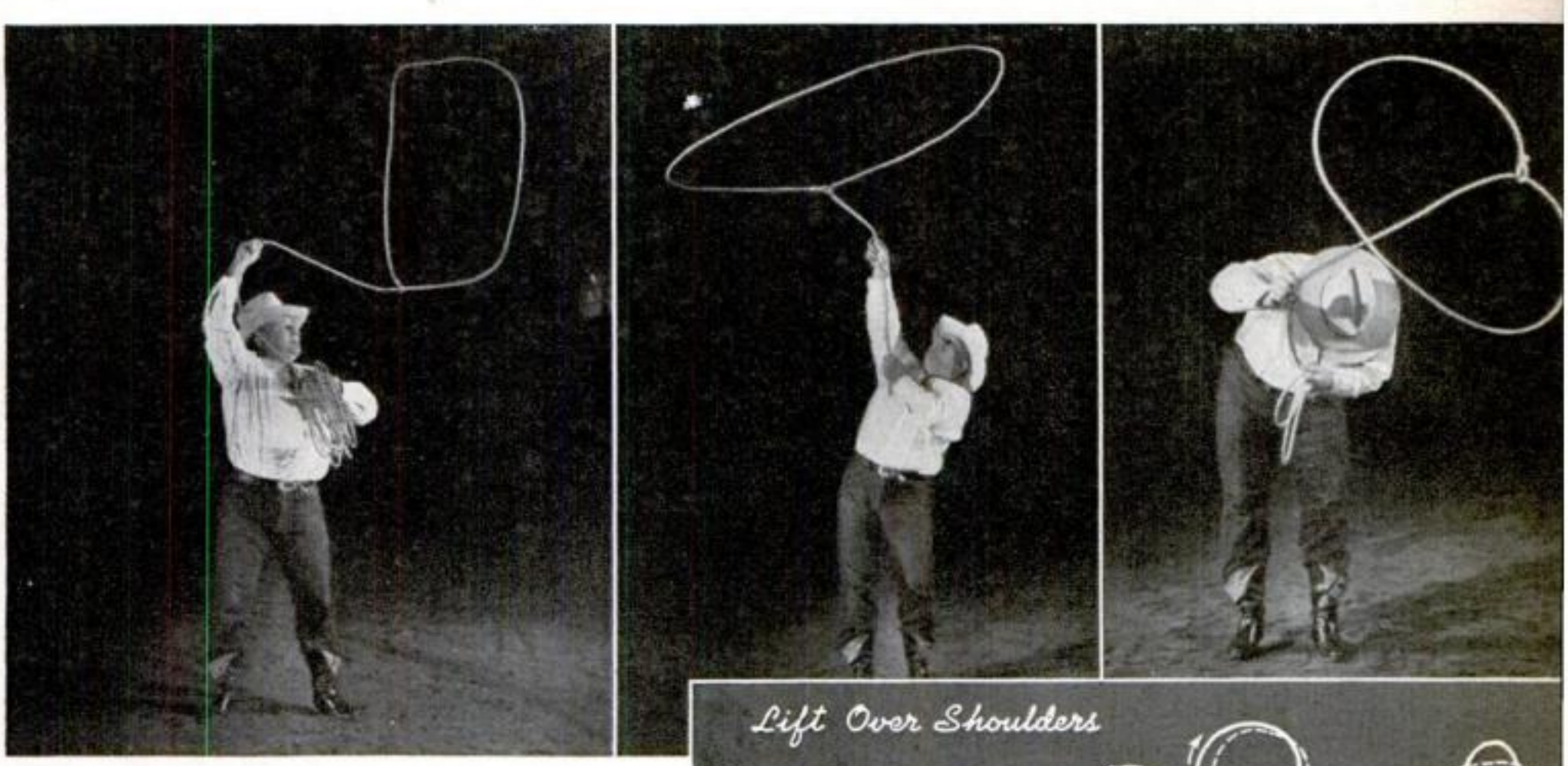


begin to overcome the twisting of the rope and the kinks that come with it. Learn to play small loops back and forth in front of you. Say, for instance, a swing of the small loop to the left to where it goes up and almost stops. As it comes back reverse the spin. This takes away the twist and starts it in the other direction.

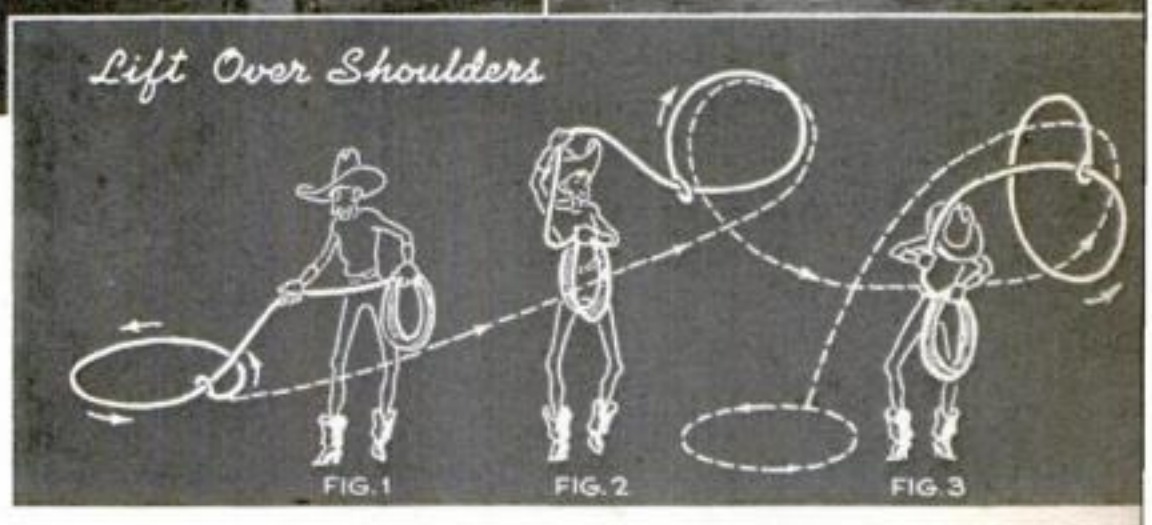
Once you have caught and mastered one of those tricks others come to you. You are now working in sequence, and you are on your way to the spectacular stunts shown on these pages.

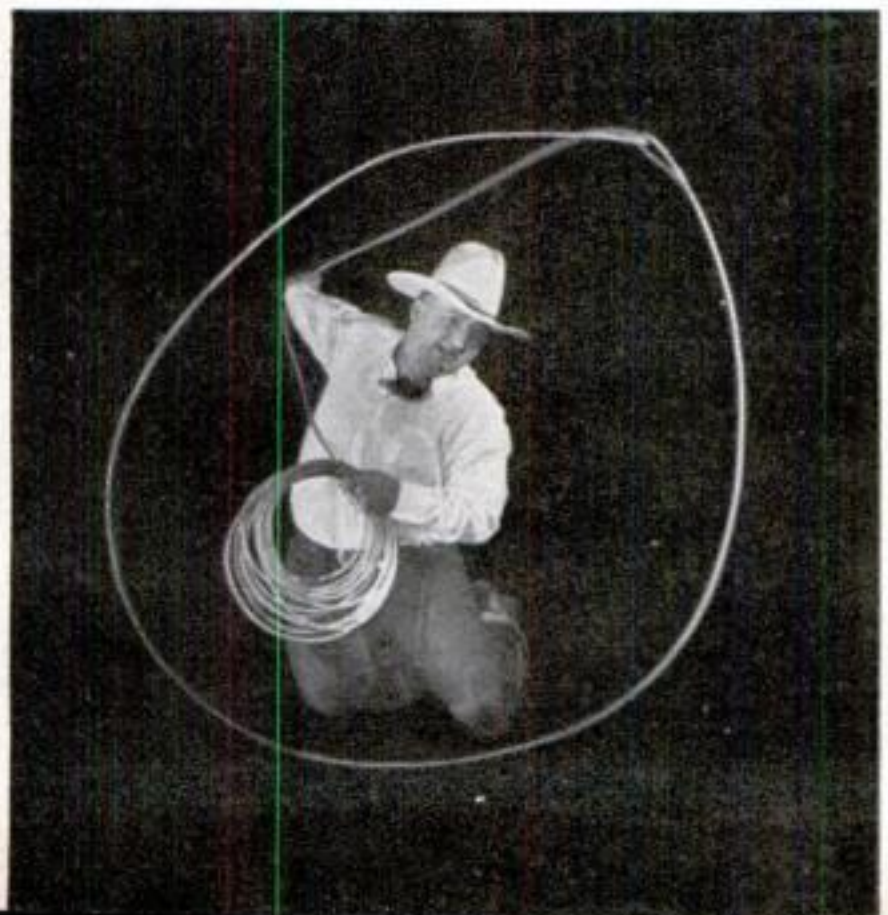
As you advance, so must your rope. Maguey ropes made from the maguey plant in old Mexico are used for fancy horse roping, in contests where experts "call their shots" —meaning the foot they intend to catch. Small loops are used to catch the front feet, a hind foot, or the stirrup of the rider; large loops are employed to catch all four feet. Horses to be roped in such contests are always managed by good riders who know how to pull up to keep them from being burned by the rope.

But you'd better enjoy this kind of roping from the sidelines until you have mastered the rope-spinning tricks.



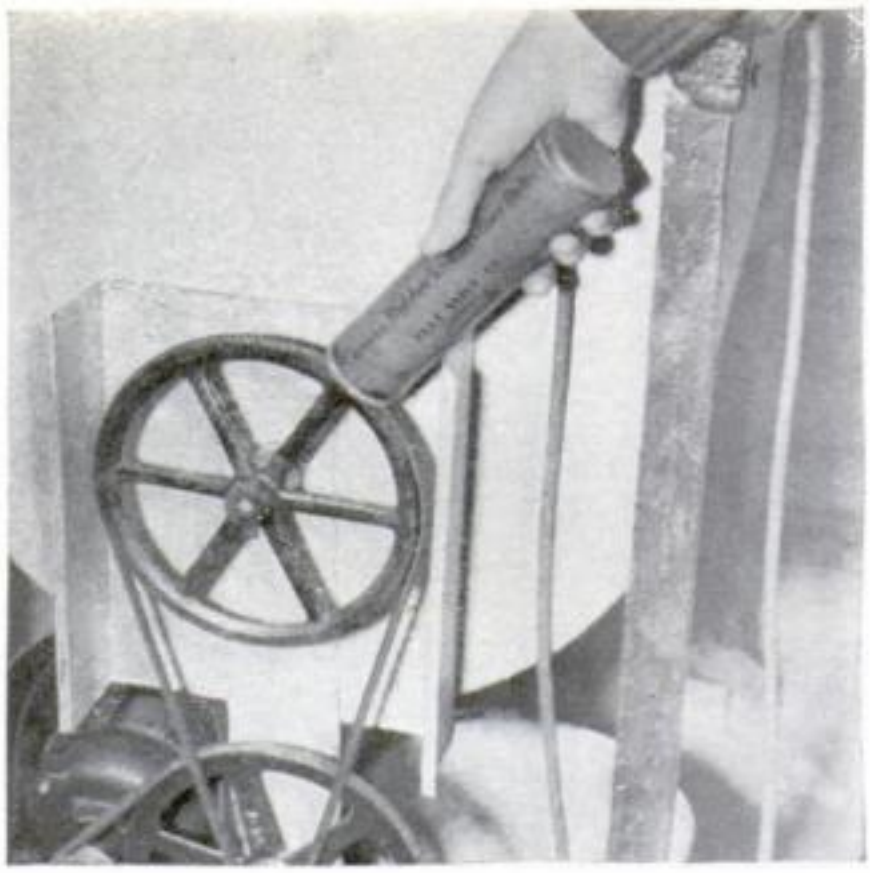
LIFT OVER SHOULDERS. In this trick, the noose is carried upward in front of the body—not jerked, but eased gradually into the position seen in the first photograph. When slightly above the head, it is thrown up and then down around the body. Timing and balance must be perfect or the trick is ruined



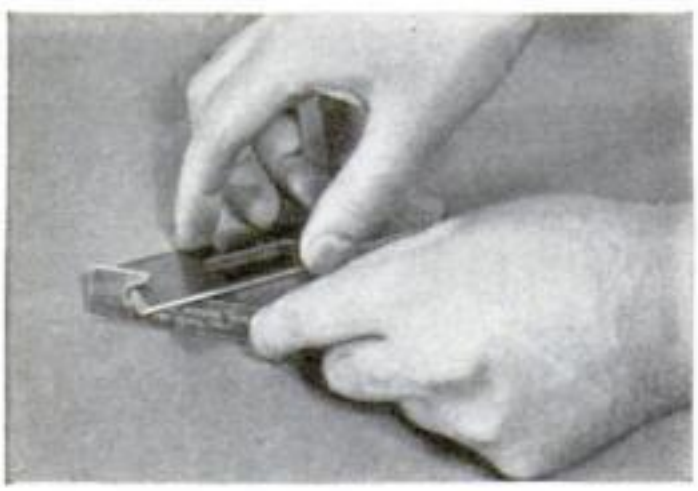


SKIP WITH VERTICAL LOOP. This is done in the same manner as the Texas Skip illustrated on page 83, except that the vertical loop is made in front of the body instead of at the side. When it is going well, pull it over the head and jump through. The loop is kept spinning after the jump by turning slightly and continuing the rotation. Frank Biron, who demonstrates the various tricks on these pages, is known all over the country as a champion trick roper, rider, bronco buster

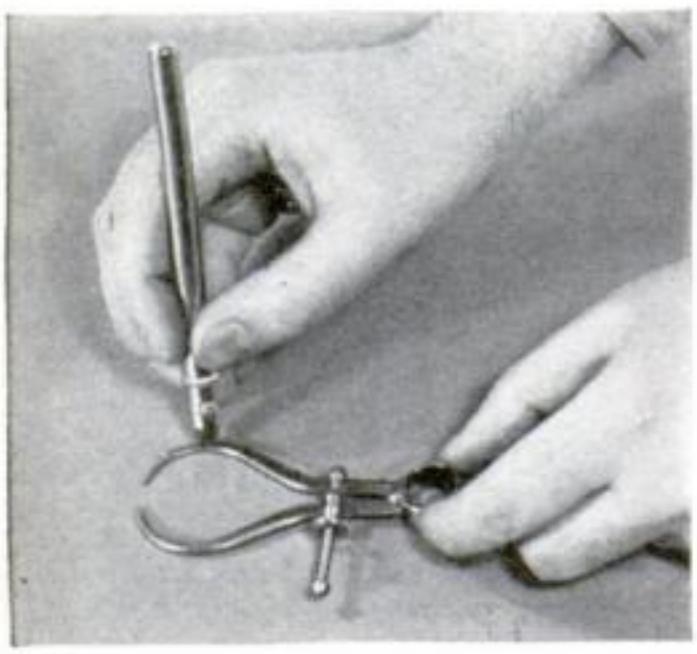
new Tools



SLIPPING MACHINE BELTS are said to take a firm hold after an application of a new compound recently put on the market. The compound, made in stick form, is applied to both the inner and outer surfaces of the belt while the machinery is in operation. Neat's-foot oil and beeswax, two constituents of the stick, keep the belt from slipping and also lengthen its life.

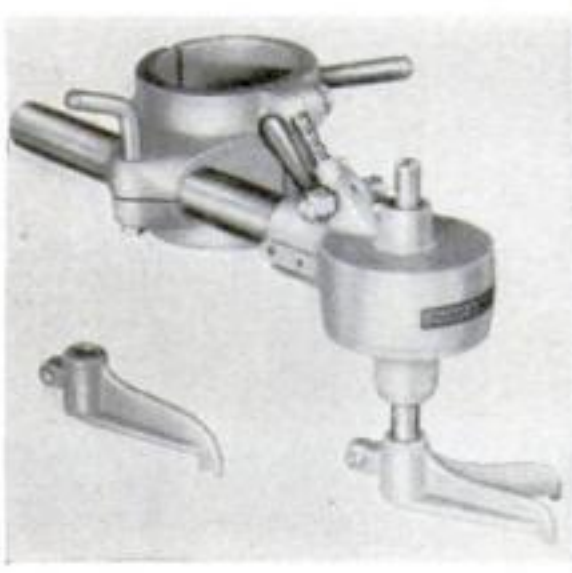


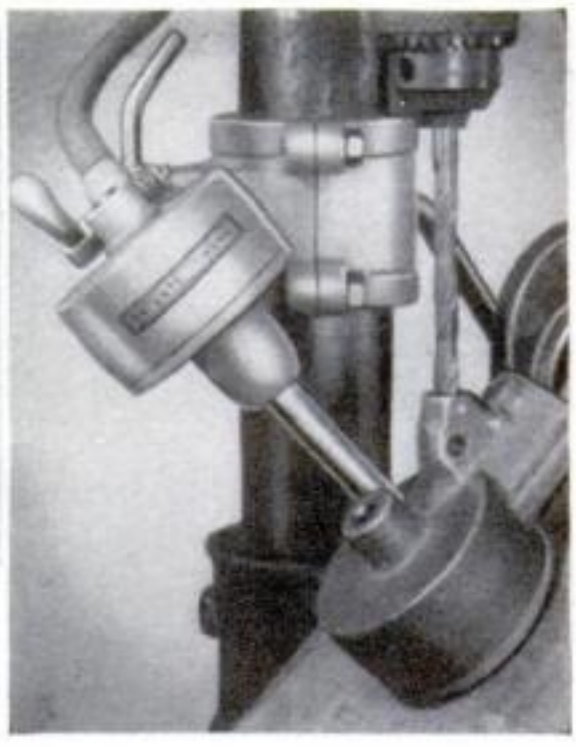
A POCKET PLANE-IRON GAUGE is now available that will show visually whether the iron has been correctly sharpened. By inserting the sharpened iron into a notch at one end of the gauge, it is possible to see whether the bevel is at the proper 25-degree angle. The gauge is constructed of stainless steel and has a hole at one end so that it may be hung on a hook when not in use. During the operation of grinding the iron, frequent checking with the gauge will enable the craftsman to preserve the proper bevel, which is as important as obtaining a sharp edge.



A NEW-TYPE AIR CLAMP speeds up drill-press work from 30 to 300 percent according to the manufacturers. Adaptable to any drill press having a cylindrical column, the air clamp may be quickly attached in any desired position. It is operated by a two-way valve on the working head although, for short operations, a foot control is available. The pressure foot may be swung a full 360 degrees.

RUST SPOTS can now be removed from tools and other metal objects by simply erasing them with an elastic-rubber compound impregnated with an abrasive. The eraser is built into a long, thin tube resembling a pencil and can be used as easily as the ordinary eraser. The new gadget is said to smooth, finish, and polish, all in one operation. It contains no ferrous metals, nor anything to cause corrosion, stain, or tarnish to any metal. Its compact form makes it easy to carry in a pocket.





New air-clamp hold-down for drill-press work. At right, it holds casting for a boring job

Moseley's Boys Make Good

Canadian Air Marshal William A. ("Billy") Bishop, left, congratulates Maj. C. C. Moseley on his work in training British cadets like those shown below

ACE CIVILIAN TRAINER OF CRACK WAR PILOTS TEACHES THEM TO GET IN CLOSE FOR THE "OLD SUNDAY PUNCH"

MAJOR C. C. MOSELEY, who piloted a Spad in France in 1918, is fighting vicariously now on every American and British front. Flyers who got their primary and basic training at his four schools in California have distinguished themselves in engagements over the North Sea and the south seas. At his four schools air cadets in the U. S. Army and the R.A.F. are putting in 50,000 flying hours each month preparatory to their final military training. Others are being gradu-

Men to fly Britain's new planes: R.A.F. trainees marching to their ships at a California field for an advanced training flight. At the right is the control tower at Cal-Aero, from which instructions are flashed to pilots both visually and by radio

ated to take their places as airplane designers and mechanics. Moseley's boys make up a formidable army already. In 1942 he will train more pilots than were graduated from American Air Corps schools between 1922 and 1939.

All of them will be imbued with the idea which dawned on Major Moseley in the air in France in 1918 only after his first few German foes had escaped his attack—the idea that the airplane's machine guns must be opened up at close range for truly murderous effectiveness.

"You've got to riddle 'em," says Major Moseley. "Give 'em the old Sunday punch in the first round."

Major Moseley's ideas on training are based not only on his own experience as a fighter, but on many years of instructing pilots. When he returned from France as a first lieutenant he was put in command of Carlstrom Field in Florida and for several months directed the training of the ever dwindling classes of cadets.

He takes pride in the achievements of his students and his continued insistence upon discipline and caution from the moment a cadet enters one of his schools until he departs for advanced training at an Army field shows the importance he ascribes to these qualities. In three years only one student at his schools has suffered a fatal accident. It is Major Moseley's firm belief that the safest, as well as the most efficient course a flyer can pursue is to put his enemy out of action as quickly as possible.

"They've been in-fighting from the beginning," he says. "They make their first shots count. They learned in the school what I got the hard way."

It was Billy Bishop, leading British ace in 1918 and now Canadian Air Minister, who indirectly got Major Moseley interested in military flying. Major Moseley, then a student at the University of Southern California, read a *Saturday Evening Post* article about Bishop's exploits and, within a few months, was himself a flyer in France. He has been an air man ever since.

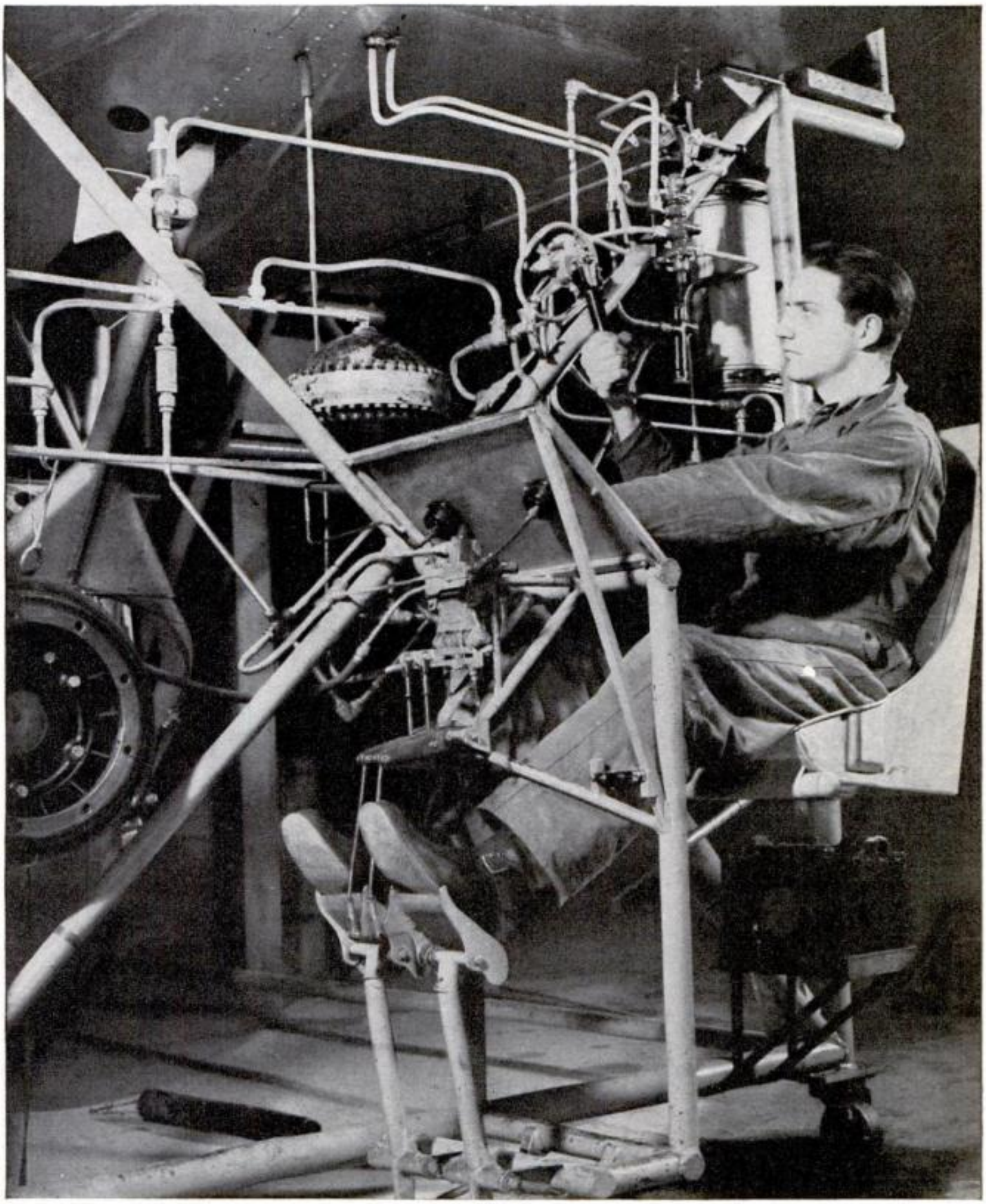
In 1919, piloting a plane sponsored by the late General Billy Mitchell in the Pulitzer race at Mitchel Field, Major Moseley established a record of 176 miles an hour and was the first winner of the Pulitzer Trophy. Then he took charge of the contraction of the Air Corps flying schools. As a captain

he directed the training program of the entire Air Corps for two years and then went to McCook Field in Ohio as a test pilot.

Resigning from the Army in 1924, he went to California and established the Western Air Express, of which he was vice president in charge of operations for almost four years. Then he leased the Grand Central Airport at Glendale, Calif., bought a small flying school, and started his training program as a civilian. Now, besides the greatly enlarged school at Glendale, he has training fields at Ontario, Lancaster, and Oxnard, all in southern California.

The future which lay before flying schools in that region had impressed him in 1922, when he took command of Clover Field in California to give reserve pilots refresher training. Between 1922 and 1924 he had

Specially built apparatus helps train mechanics in Moseley's Curtiss-Wright Technical Institute, at Glendale, Calif. This mock-up of a plane cockpit shows operation of controls that usually are hidden



Another piece of special equipment shows student mechanics just how the landing gear of a four-engine Boeing stratoliner works. These boys will soon be helping to keep our air armadas flying

A "jackpot" banks for a turn. New men are required to look around and bank with their arms every time they round a corner on the ground. This instills the idea of safety, besides affording some satisfaction to older students

held commissions both as a captain in the Army and as a major in the California National Guard, for which he had organized an air squadron.

His first private air school at Glendale was his chief interest until 1939 when General H. H. Arnold, chief of the Air Corps, consulted him about the feasibility of giving air cadets their primary and basic training at civilian schools. Major Moseley was enthusiastically confident and expanded his Grand Central field at Glendale and built another, the Cal-Aero Field at Ontario. Within forty days he had them ready for his first 100 students. He also began training American Eagle pilots for service in Great Britain and recruits for the Royal Air Force, which made it necessary to have two more schools. He has just one ambition and is so busy that he doesn't know whether he has realized it or not.

"It's very simple," he said, when asked about it recently at the Glendale field. "My immediate objective is to run the best flying school in the world. That means keeping our safety record at the top and turning out crack combat pilots." The Moseley schools took top safety honors last year.

"Dead students and smashed training planes don't help beat the enemy," said Major Moseley. "Remember, this is no game. We're making combat pilots. A combat pilot has one job and only one: he must shoot the other man down, kill him if possible, so he can't come back another day."

Major Moseley holds that there are five essentials which the good combat pilot must have—instrument flying, navigation, night flying, formation flying, and gunnery. Everything else, he says, is so much fluff. His schools do not give instruction in gunnery, but when students depart for their final Army training they carry in the front of their minds the gunnery lesson Major Moseley learned in France—"Give 'em the old Sunday punch in the first round." And they have been handing out the old Sunday punch to German and Japanese flyers.

Graduates of the Cal-Aero at Ontario,

the Polaris at Lancaster, the Mira Loma at Oxnard and the Curtiss-Wright Technical Institute at Glendale, the latter the site of the old Grand Central field have been heeding the pungent instructions: "Keep your nose up, look around, hold your punch and get in close."

Cadets thrilled to read an open letter Moseley had posted at all schools recently:

"Lieut. Earl Stone got three Jap ships while on dawn patrol in the Philippines. Lieut. Harry Brown singlehanded shot down the leader of a Jap rendezvous in the Pearl Harbor attack and scattered the flight. Lieut. Edward Barr shot down the first Jap plane of the war. Lieut. George Welch has won the Distinguished Service Cross for downing four Jap planes at Hawaii. Lieut. Grant Mahoney got the D.S.C. for the amazing achievement in the first battle of the Philippines of shooting down a flying boat, strafing an enemy radio station, securing vital enemy information in face of blistering fire, and landing his ship with a bomb dangling from an improperly functioning rack."

I saw that note at Grand Central, on the desert at Polaris, up the coast at Mira Loma, and among the orange groves at Cal-Aero. Students who paused to read walked away with their jaws set just a little more firmly. Those were Moseley's boys who had taken the Japs. Only last summer they, too, were pushing these training planes through the Southern California sky. Soon the present crop of students will join them in defending America's frontiers. If their determination is any criterion, they'll match those achievements.

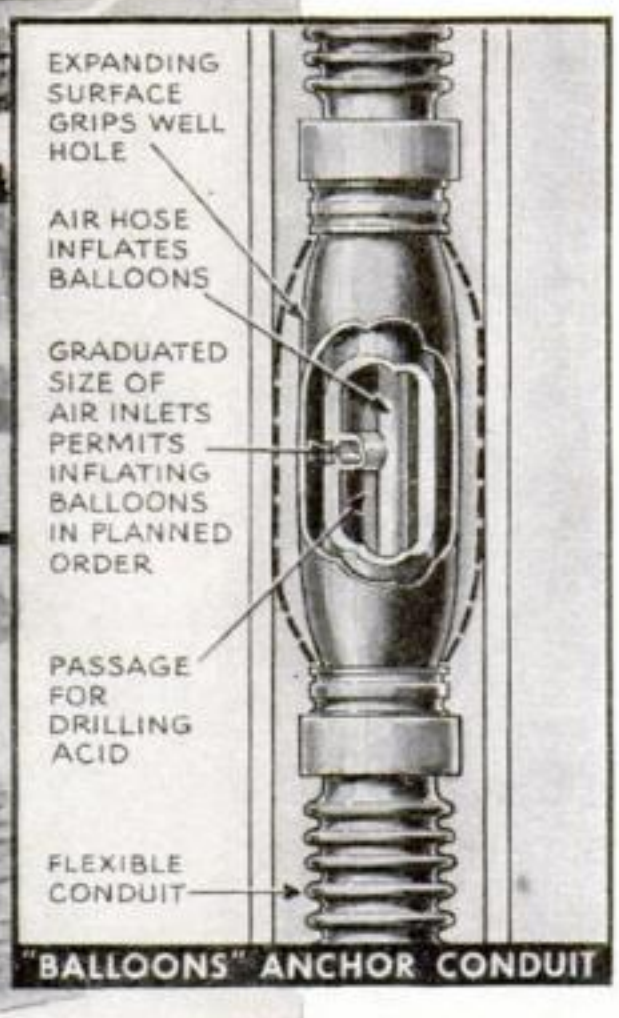
The Moseley boys have been making progress on British air fronts too. Pilot Officer Carroll McColpin has bagged six German planes and the D.S.C. Robert Mannix, Art Roscoe, Bob Sprague, and Ross Scarborough each got two German planes. Tom Wallace sent a Messerschmitt into the English Channel. Donald Gaffene is credited with an enemy plane, a series of oil storage tanks and a military train. Charles Tribken got three enemy aircraft and a railroad junction. Pat Dowling, whose bomber was riddled with bullets over the North Sea, brought it back home.

It shows that Major Moseley gives the Army instructors a sound foundation on which to build. It vindicates his insistence upon discipline and caution, which some of the cadets find a trifle trying in a civilian school. Nevertheless, the underclassmen or "jackpots" at the Moseley schools have to take their corners square, look straight up and bank with their arms. Every boy must always look up and around before any maneuver and remember the rule: "This school is dedicated first to safety and second to technical perfection."—ANDREW R. BOONE.

Ready to fight for the R.A.F., a British student gets his graduation certificate from Major Moseley at War Eagle Field, Lancaster, Calif., before Air Marshal Guy Carrod, in charge of British training

MECHANICAL

Drills Through Rock with Acid

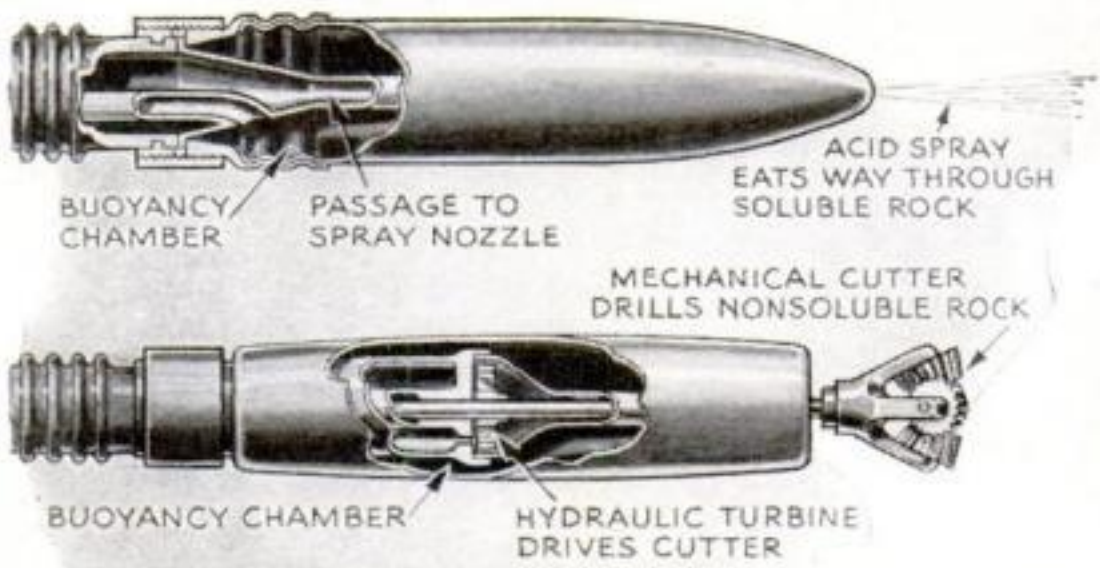


"BALLOONS" ANCHOR CONDUIT

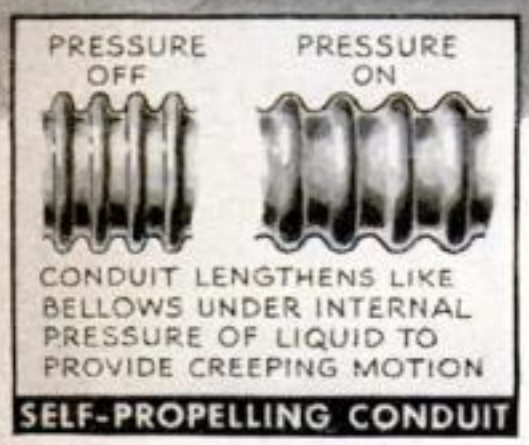
GUIDED by remote control from the surface, a mechanical mole burrows horizontally, up, or down through the depths of the earth, in a radical new system of well-drilling developed for the Dow Chemical Company of Midland, Mich. Only one main shaft need be sunk to drain all parts of a "pay formation" of petroleum, natural gas, water, or brine, from which the firm extracts lightweight magnesium metal for airplanes.

Lowered into this shaft at the end of a flexible conduit, the torpedo-shaped mole is directed outward at any depth and in any direction by a curved guide called a whipstock. Wherever the radial path of the tool encounters a subterranean pool,

CUTAWAY VIEW SHOWS "MECHANICAL MOLE" EXPLORING UNDERGROUND FORMATIONS

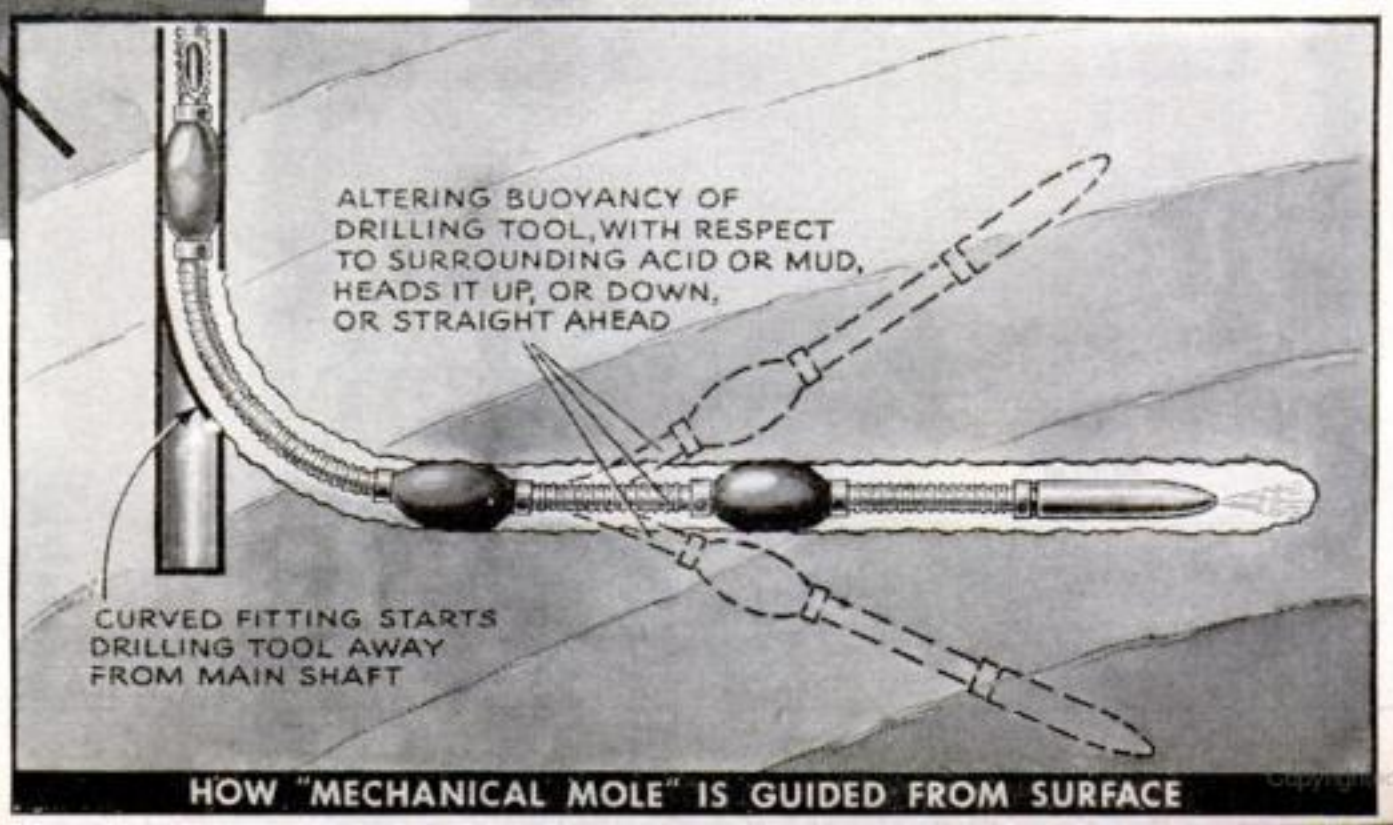


TWO TYPES OF DRILLING TOOLS



SELF-PROPELLING CONDUIT

Drawings by STEWART ROUSE



HOW "MECHANICAL MOLE" IS GUIDED FROM SURFACE

MOLE BORES CROOKED WELLS

or Hydraulic Cutter, Biting Way Up, Down or Horizontally

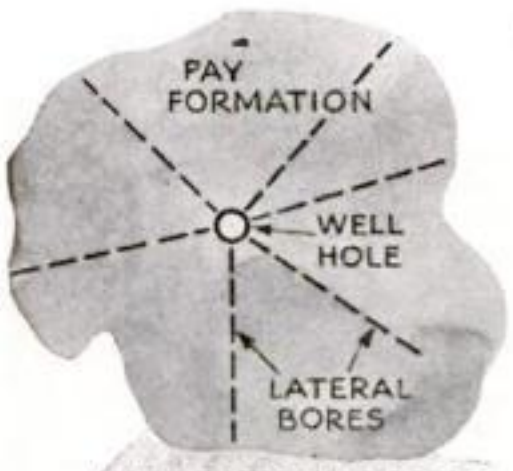
the contents pour into the lateral bore and thence to the vertical one. Thus the scheme saves the untold time, labor, and cost of boring a large number of deep wells from the surface.

Hydrochloric acid, pumped down the conduit under high pressure, spurts through a nozzle in the mole to drill a passage through soluble rock like limestone. If the rock resists acid, water drives a hydraulic turbine, in a second type of mole, to operate a mechanical cutting tool at its head.

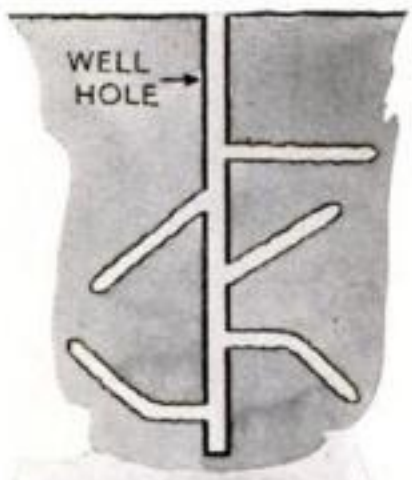
To advance the mole periodically through the hole it bores, a "creeping conduit" and inflatable "balloons" act together. Patterned after bellows, the conduit lengthens under internal pressure, and contracts when pressure is released. Alternately anchored at each end during the operation, it travels forward in inchworm style. Reinforced balloons, inflated with air or liquid, serve as anchors. Their inflation ports decrease in size from the uppermost to the lowest, so that the one nearest the mole will be the last to deflate and the last to inflate again. Thus the mole is successively held fast while the conduit shortens, pushed forward as the conduit lengthens, and finally reanchored in its new position. Extra sections of conduit are added at the surface as needed.

To follow an inclined formation, an inner chamber of the mole may be filled with air or liquid to regulate its buoyancy with respect to acid or mud in the drilled hole. Making the mole more buoyant heads it upward, while reduced buoyancy makes it descend. By means of a hydrostatic gauge above ground, engineers may check the exact depth at which it is drilling.

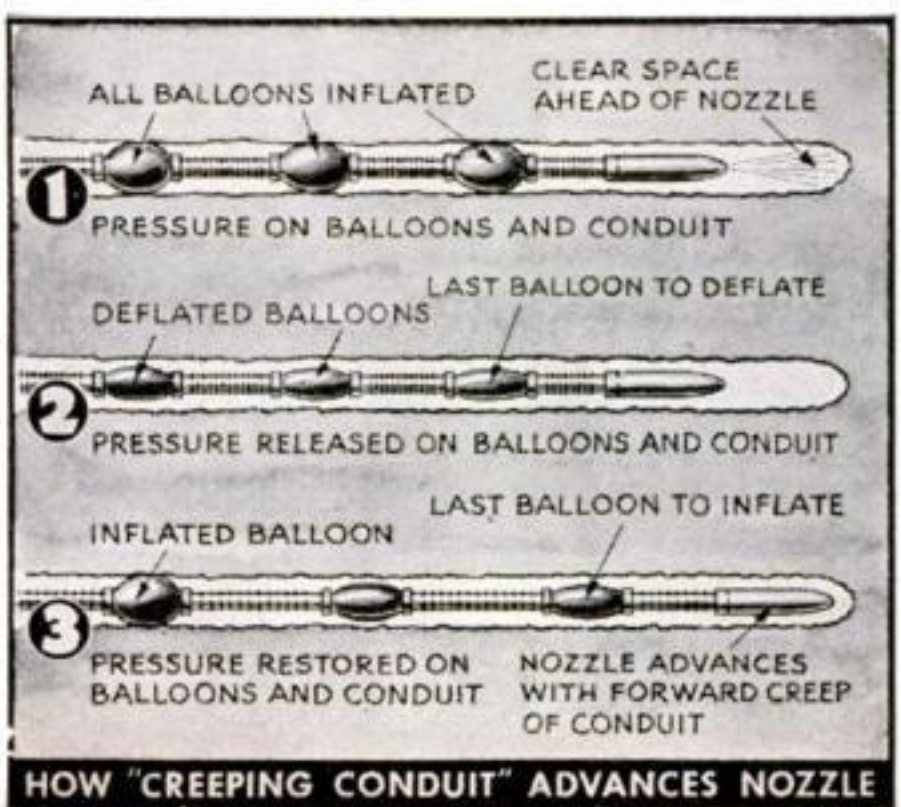
The central shaft itself may be sunk by conventional well-drilling means. However, the mechanical mole may bore this vertical hole, too, thus serving for the entire operation.



HOW RADIATING BORES TAP WHOLE AREA SURROUNDING CENTRAL WELL HOLE, WITHOUT EXPENSE OF SINKING MANY WELLS FROM SURFACE



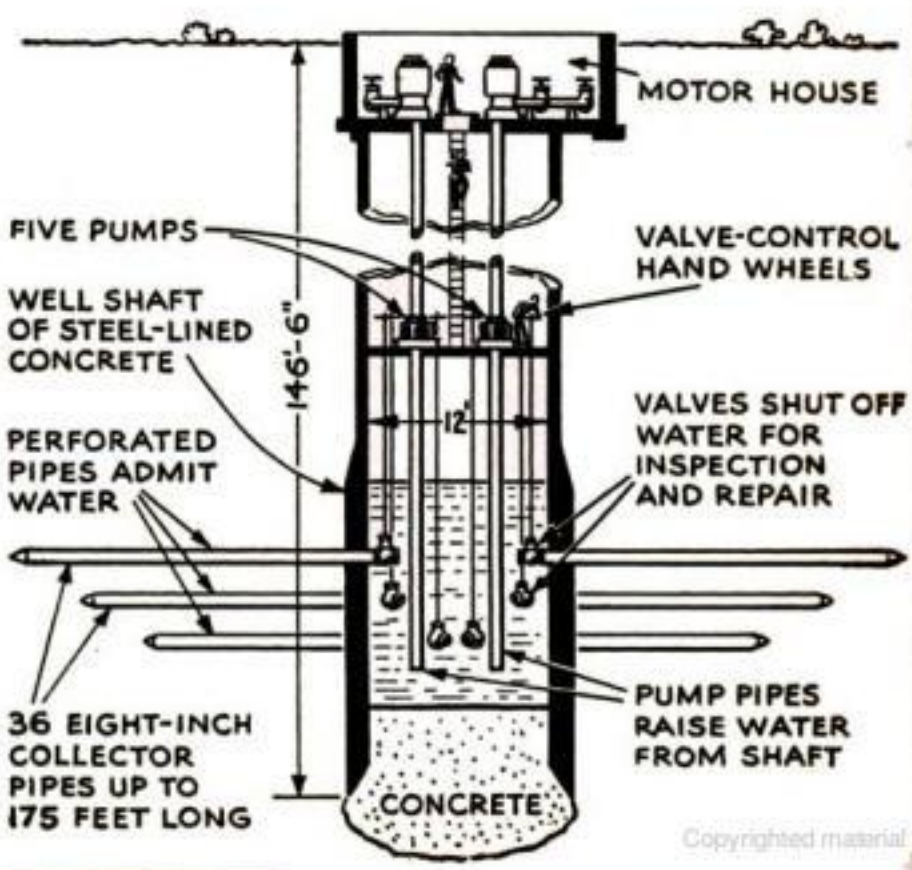
"MECHANICAL MOLE" BORES THROUGH PAY FORMATION IN ANY DIRECTION, GUIDED FROM SURFACE



HOW "CREEPING CONDUIT" ADVANCES NOZZLE

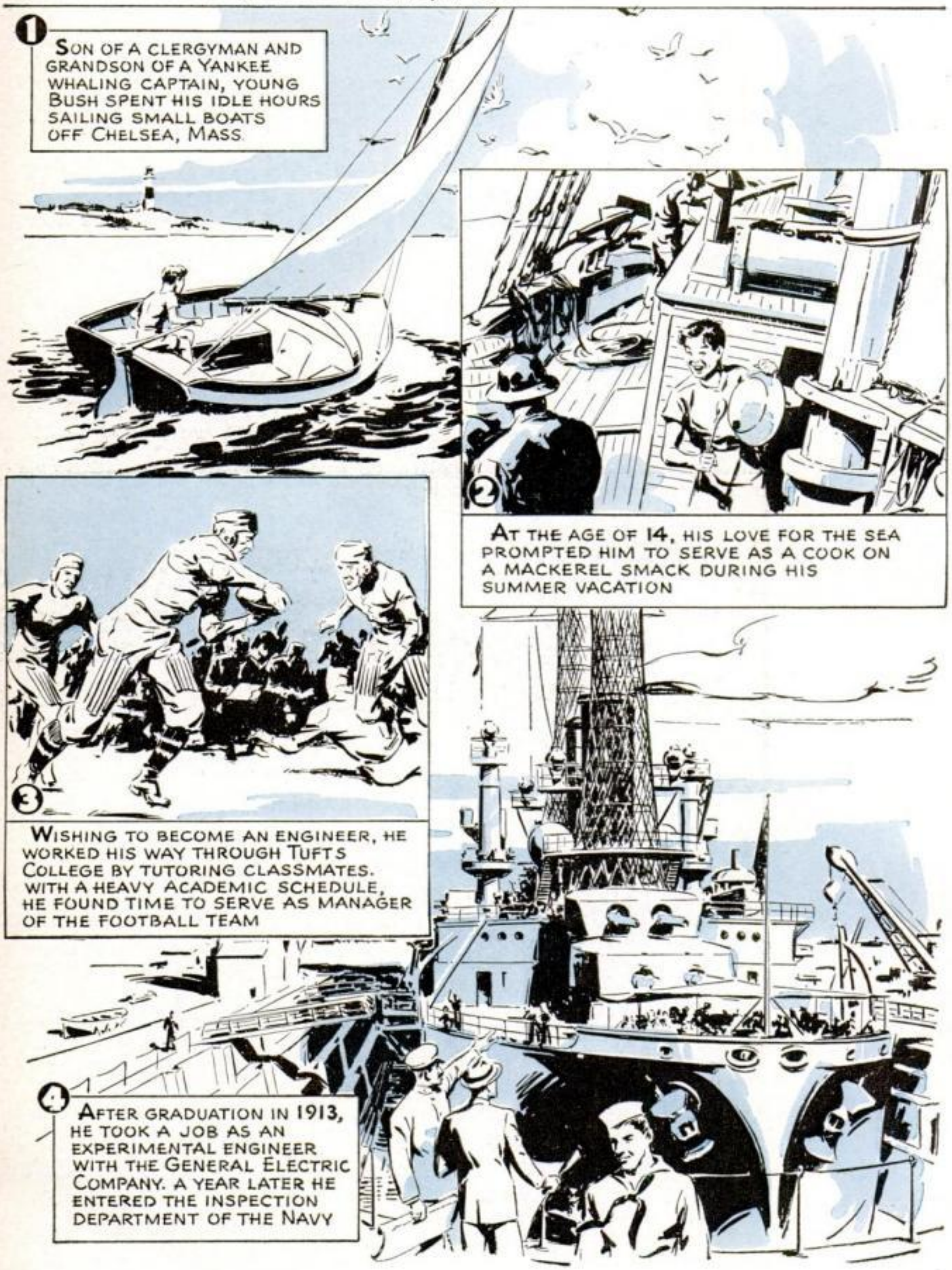
Huge Water Well Draws Supply Through "Wagon-Wheel" Intake

BELIEVED the largest ever built, a water well nearly 150 feet deep, at Canton, Ohio, employs a "wagon-wheel" intake suggesting the plan described above. In this case, the enormous 12-foot diameter of the shaft permitted access to the bottom, where perforated inlet pipes were driven outward by hydraulic jacks in 7½-foot sections.

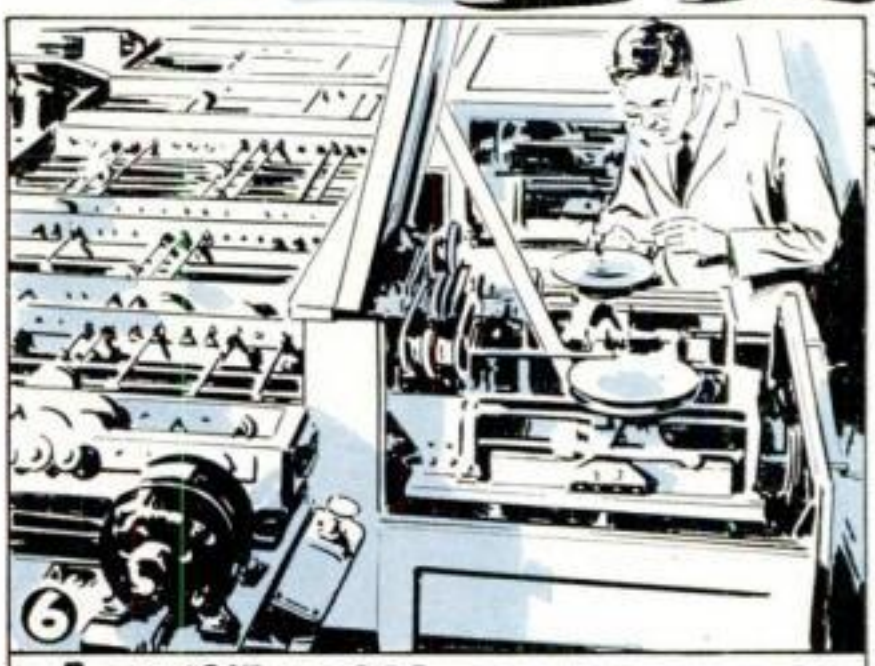


Here's My Story

DR. VANNEVAR BUSH, HEAD OF THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT. WAS BORN AT EVERETT, MASSACHUSETTS, IN 1890

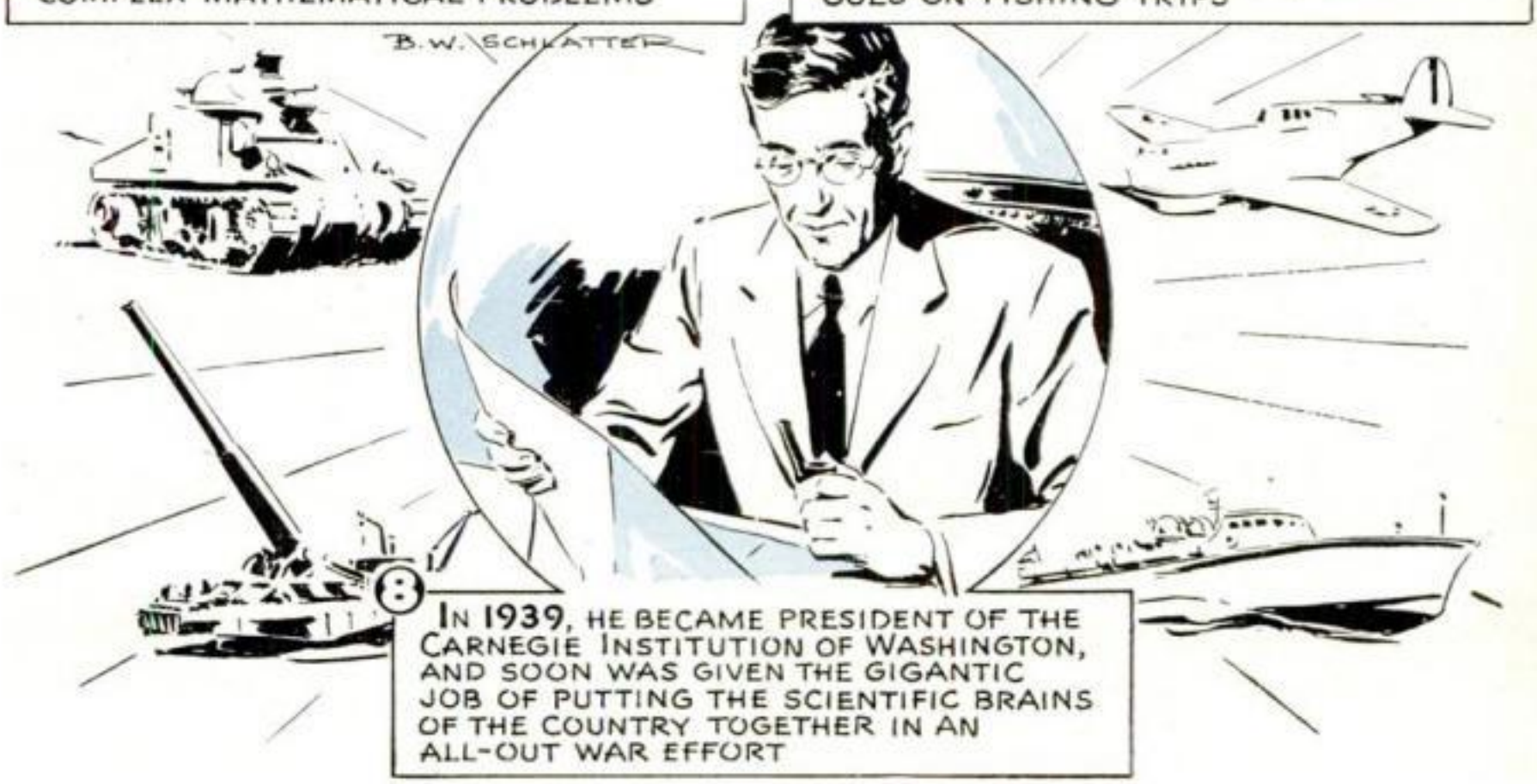


THE CAREER OF
DR. VANNEVAR BUSH

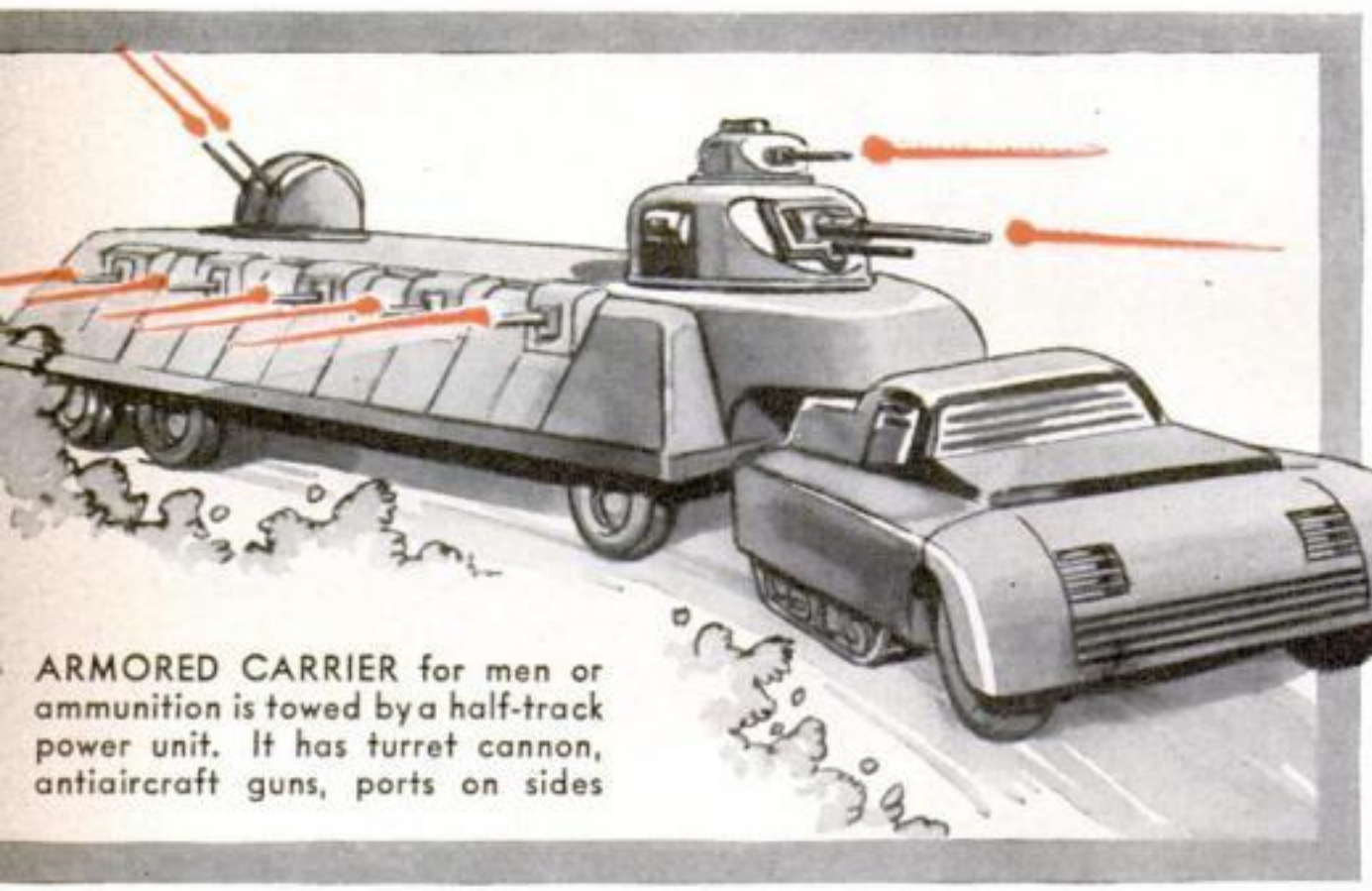


FROM 1917 TO 1939, HE WAS CONNECTED WITH M.I.T., HERE DEVELOPING HIS FAMOUS THREE-TON DIFFERENTIAL ANALYZER WHICH RAPIDLY SOLVES COMPLEX MATHEMATICAL PROBLEMS

ASIDE FROM HIS SCIENTIFIC VENTURES, DR. BUSH RAISES TURKEYS ON HIS NEW HAMPSHIRE FARM, PLAYS THE FLUTE, SAILS HIS OWN YACHT, AND GOES ON FISHING TRIPS



GROUND STRAFER. Seventy-five heavy guns, mounted in five banks of fifteen guns each with their barrels radiating from a revolving drum, would give a low-flying attack bomber devastating fire power against the enemy below. A touch of a button fires one bank of guns out through a port in the belly of the plane; the drum is then turned to bring another bank into firing position



ARMORED CARRIER for men or ammunition is towed by a half-track power unit. It has turret cannon, antiaircraft guns, ports on sides

BOMB BAYS for flying boats open from the side of the craft, in a patent assigned to Boeing. This offers a solution to the problem of dropping bombs from big patrol bombers which must have water-tight hulls. Inclined rails leading from the bomb racks guide released missiles to the ports, where they are deflected from their outward course to preserve their aim

Inventors Offer Thousands of Ideas to Help Beat the Axis

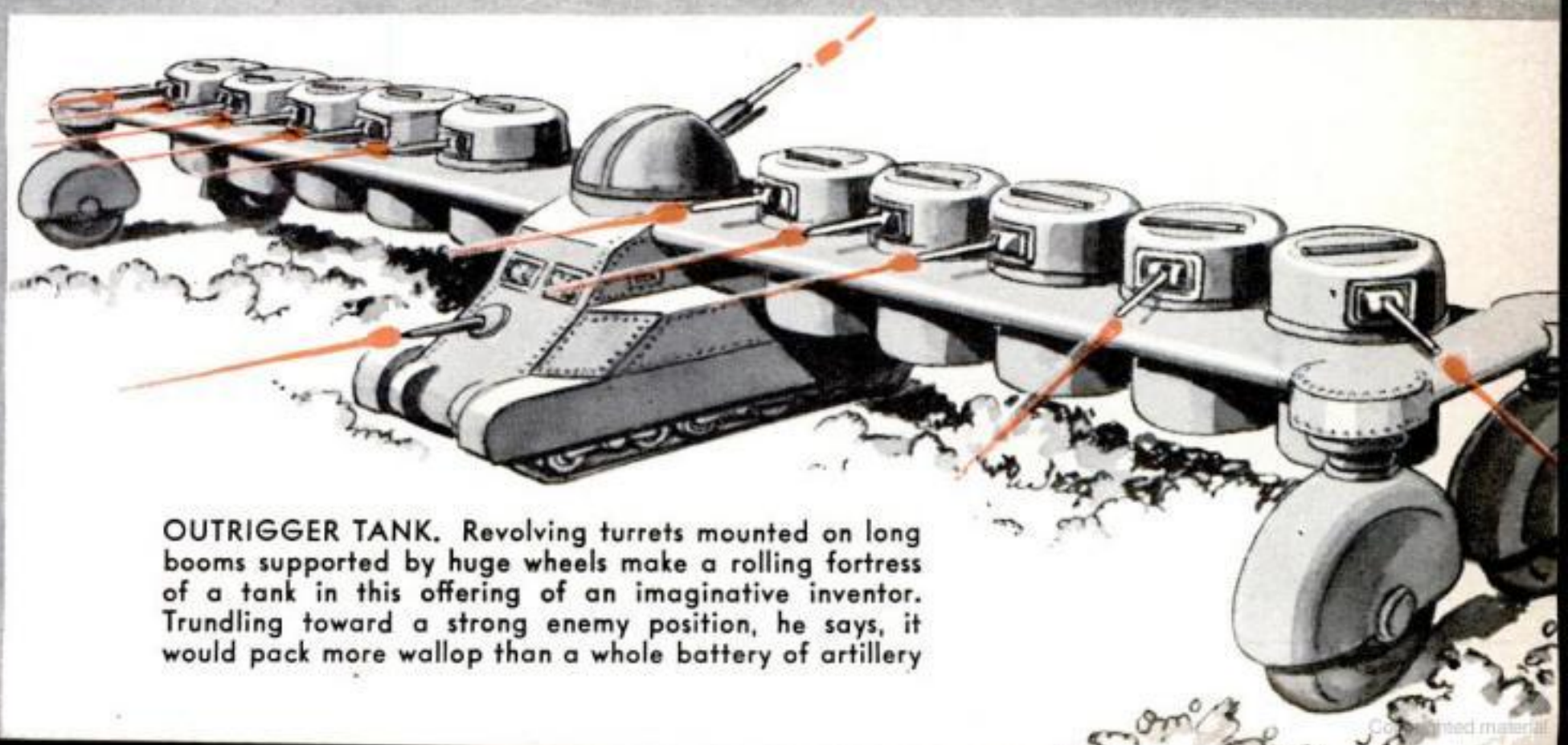
WAR inventions are flooding the National Inventors Council and the U. S. Patent Office. At the Council's headquarters in Washington, D. C., 45,000 suggestions have been received during the last year. And 3,000 of them have been adopted—one out of 15, an amazingly high proportion that pays tribute to American inventive ability. Results have well justified the effort of sorting valuable new ideas from equally well-meant schemes that prove unsuitable for various reasons.

Illustrations on these pages typify the variety of ways proposed to beat the Axis. To meritorious ideas, the National Inventors Council assigns an "A" or "B" classification, the first for inventions specifically requested by the Army or Navy. According to a recent announcement, the following will be particularly welcome:

Centrifugal, electromagnetic, and air guns; rocket-propelled projectiles; explosives from hydrocarbon vapors; remote-controlled sea and air torpedoes; mobile servicing and repair equipment for motor vehicles and aircraft; lightweight armored clothing; improved airplane catapults and retarding devices, land and submarine mines, tanks, searchlights, anti-aircraft guns, small arms, mobile landing-field floodlight equipment, and gun and bomb sights.

Experts who pass upon these and other military inventions include the Council's chairman, Charles F. Kettering, of the General Motors Corporation; its vice-chairman, Thomas Midgley, of the Ethyl Gasoline Corporation; Conway P. Coe, U. S. Commissioner of Patents; William D. Coolidge, vice-president of the General Electric Company; Fred Zeder, Chrysler Corporation engineer; and F. Sparre, du Pont's director of development.

Drawings by B. G. SEIELSTAD



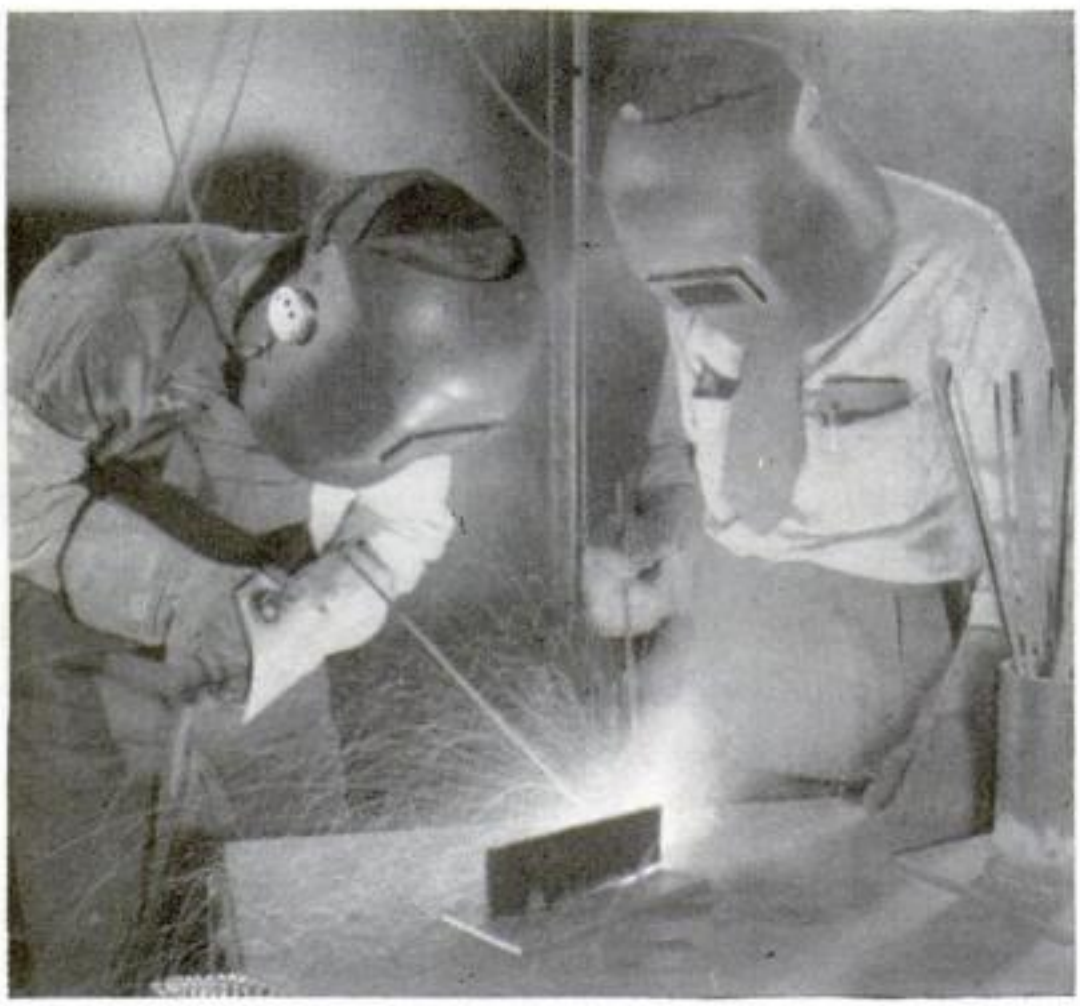
OUTRIGGER TANK. Revolving turrets mounted on long booms supported by huge wheels make a rolling fortress of a tank in this offering of an imaginative inventor. Trundling toward a strong enemy position, he says, it would pack more wallop than a whole battery of artillery

Portable Sound-Detector Units Made for Airplane Spotters

A SELF-CONTAINED sound detector, easily carried and operated by one person, makes it possible for individual aircraft spotters to hear approaching aircraft through a set of earphones. When the low-pitched sound is picked up, the spotter slowly turns his body until the sound is loudest. He is then facing in the direction of the plane and can orient his binoculars. The headpiece of this detector consists of earphones topped by a concentrator. Made of thermoplastic material, this is molded to a parabolic curve and contains crossed perpendicular veins which sharpen the aural focus on a sensitive microphone. Amplification is supplied by a three-tube unit slung over the spotter's shoulder and housed in a case smaller than the usual gas-mask container. A volume-control knob regulates the sound in the earphones to the watcher's comfort. Special filters eliminate noises other than those of a plane.

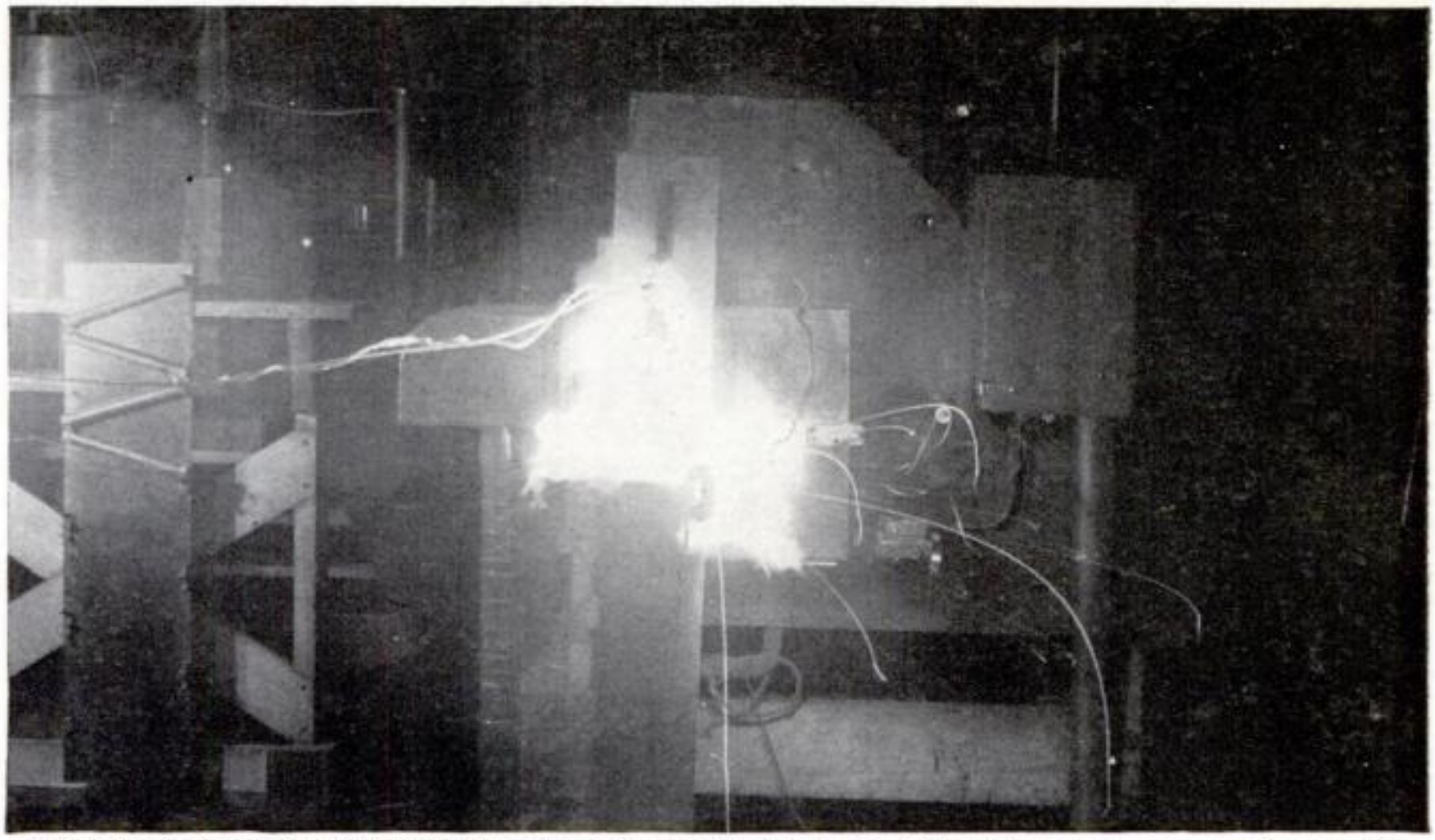
Welders' Helmets Wired for Sound So Instructor Can Talk to Pupil

A NEW METHOD of instruction in welding involves the use of a telephone between the instructor's welding helmet and that of the apprentice. In this way, the instructor is able to talk in a normal voice without risking injury by removing his helmet to make himself heard. The transmitter and earphone are plugged to a wall box inclosing four "B" batteries, and the wires are suspended overhead by ring supports. Each step can be explained during the welding process instead of waiting until the work is done.



These two welding helmets, designed for instruction, are connected by a phone line, with transmitter for the teacher and earphones for the pupil

As the pupil (left) performs actual welding operation, his teacher tells him what is wrong, without risking flash injuries by taking off helmet

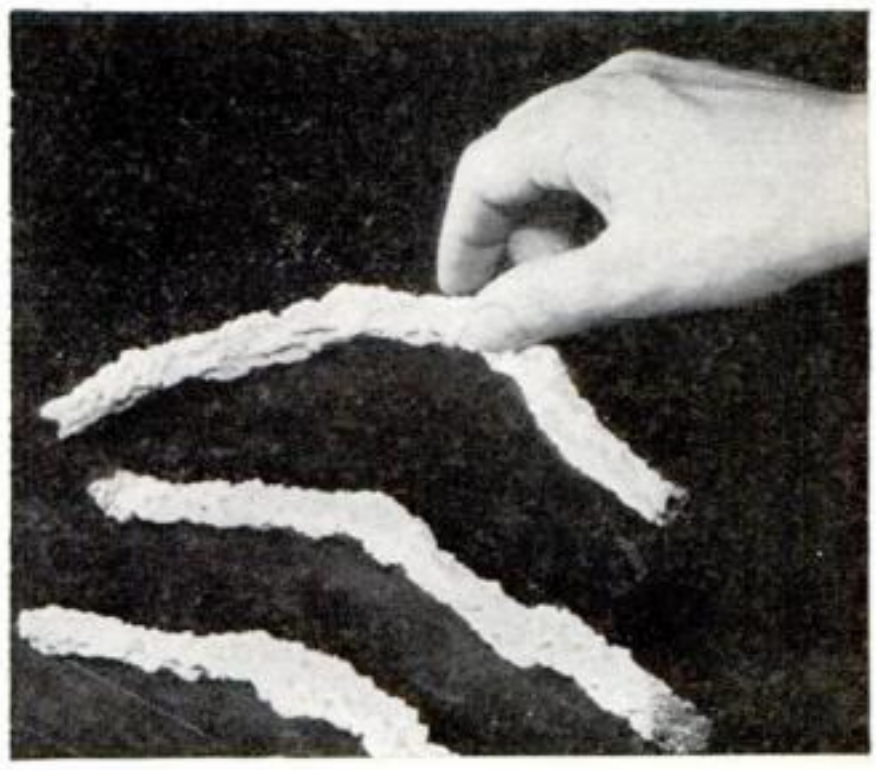


A flash of 'hot' artificial lightning is produced in the Westinghouse high-voltage laboratory at Sharon, Pa.

"Petrified Lightning" Is Formed by Catching Man-Made Bolts in Sand

BY CATCHING bolts of artificial lightning in a pail of sand, Westinghouse engineers duplicate one of nature's rarest phenomena. The research workers obtain man-made fulgurites—glasslike tubes of crooked shape, formed when a lightning bolt strikes and fuses sand during its search for an electrical ground. Natural fulgurites, they explain, are difficult to find. The sand must be of exactly the right composition. Moreover, the lightning stroke cannot be of the "cold" type that lasts for only a few millionths of a second, but of the "hot" kind with a duration of as long as a tenth of a second—enough to set fire to wooden barns and to melt rock. This is produced with a surge generator, used to test transformers. Exhibits of "petrified lightning" are being prepared for educational institutions.

A fulgurite is taken from a bucket of sand through which a bolt of man-made lightning has passed. The glasslike tubes, shown at right, are formed when the lightning melts the sand at over 3,000 degrees



GAS ATTACKS FROM THE AIR

By COL. ALDEN H. WAITT, C.W.S.

WHEN the almost incredible striking power of air chemical warfare is revealed, the world will be as surprised as it was by the success of the first German mass attacks by tanks and mechanized troops supported by airplanes. Chemicals could be used from the air on a tremendous scale—not by single flights or squadrons of aircraft, but by massed squadrons of planes dropping gas in overwhelming quantities.

There is no doubt that the airplane provides the best method of disseminating certain types of gases, and I am confident that large-scale dispersion of mustard, or the other powerful blister gas, lewisite, would cause a complete revision of our present ideas of how to wage war. Despite treaties and international agreements, no nation has abandoned the chemical weapon.

The problem of protection against gas is tremendously complicated by the airplane, and the country must recognize and prepare for the added burdens which air chemical warfare might put upon it. During the first World War chemicals were not used from the air; gas was dispersed entirely by ground weapons, and never penetrated more than ten or 12 miles behind the front lines. Today the wide radius of action of aircraft and the development of effective means of projecting gas from airplanes radically change the entire aspect of chemical warfare.

There will no longer be any areas in which anti-gas measures are unnecessary; anywhere that a bomber can reach there may be danger of gas. Industrial and transportation centers far behind the actual combat zones, as well as communication lines, troop concentrations, food and ammunition dumps, and all military installations, may be subject to attack; and at all points within range of enemy aircraft protective equipment will be maintained ready for instant use.

When the words "chemical warfare" are mentioned, most people immediately think, "poison gas." Although this term is widely used, it is really a misnomer, for most of the chemical combat substances are liquids and solids. They are roughly classified by American military authorities as "persistent" and "nonpersistent." If no protection is needed after ten minutes, as is generally the case with phosgene, chlorine, and other highly volatile gases which vaporize entirely at the moment of release, they are nonpersistent. If the amount effective after ten minutes is enough to make a man put on his gas mask, the substance is said to be persistent.

Some of the liquids which will be used in future air chemical warfare are remarkably

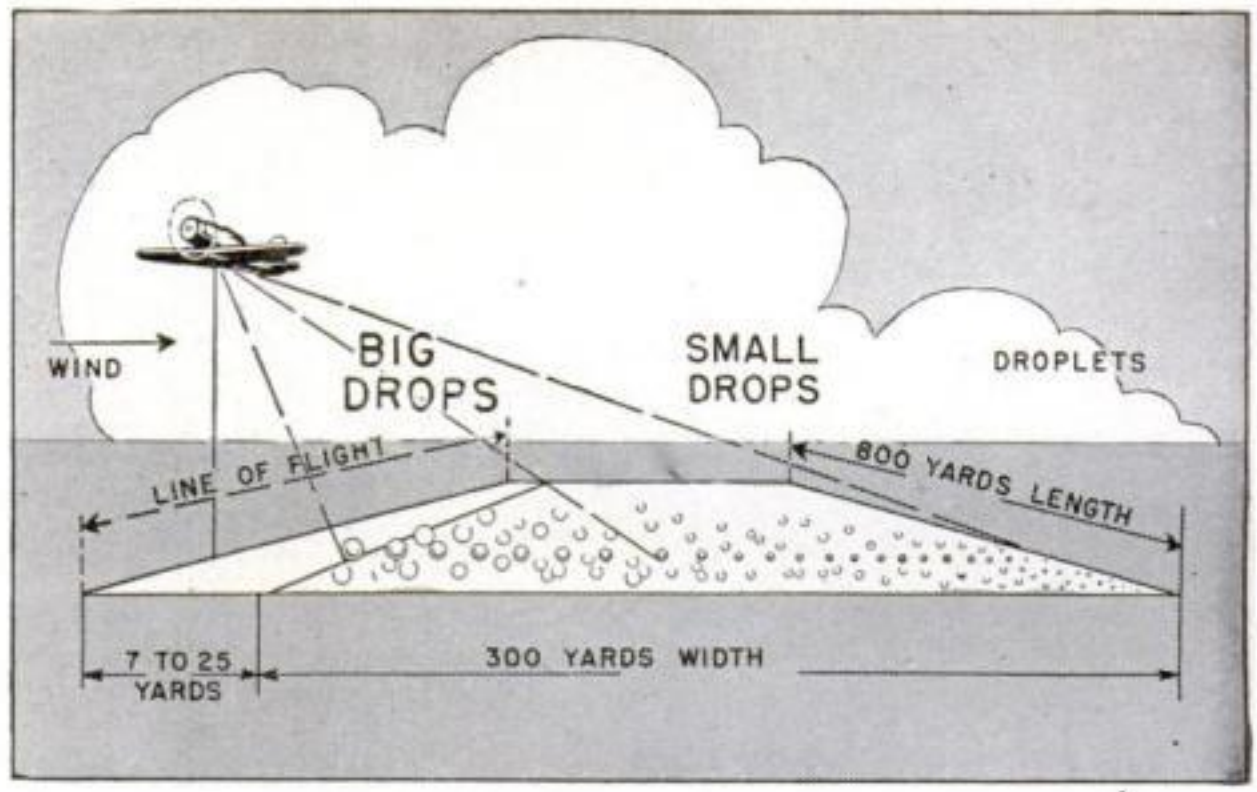
FOUR IMPORTANT WAR GASES

NAME	CHEMISTRY	REMARKS
PHOSGENE	Formula: $COCl_2$. Vapor weight, 4.11. Specific gravity, 1.43 (air as 1).	Non-persistent (effectiveness lasts about 10 minutes). Irritates mucous membranes, followed by lung edema. Detection: smell. Protection: gas mask.
CHLORINE	Formula: Cl_2. Vapor weight, 2.95. Specific gravity, 2.47 (air 1).	Non-persistent, toxic, irritant to respiratory organs. Masks afford full protection. Common use unlikely as it is part of stronger gases.
MUSTARD	Formula: $S\begin{matrix}\swarrow CH_2\text{-}CH_2\text{-}Cl \\ \searrow CH_2\text{-}CH_2\text{-}Cl\end{matrix}$ Note chlorine, more effective here than alone.	One of so-called blister gases, and most persistent and effective of all war gases. Penetrates clothing and affects all parts of body. Protection: air- and waterproof clothing, mask.
LEWISITE, or M1	Mixture of three chlorvinyl derivatives of arsenic trichloride. Note this also uses chlorine.	A persistent blister gas with properties similar to mustard; regarded by some experts as better. Detection (pungent odor) and protection same as those for the penetrating mustard gas.

How a heavy bomber spreads gas by sprinkling it as a liquid. Forced out of the nozzle backward at a speed equal to the forward air speed of the plane, the liquid settles down in large drops like rain. It is estimated that 700 pounds of chemicals sprinkled by a plane flying at 1,000 feet will cover an area of ground 1,000 feet wide and 4,000 feet long

persistent. Mustard gas, still regarded as probably the most effective casualty-producing gas yet developed, remains effective on the ground in the summer from a day to a week or more, and in cold weather it may persist for several weeks. Throughout that time it is a constant danger.

Persistent chemicals may be used from the air in several ways. They may be released from tanks carried in the bomb racks and under the wings of airplanes, or placed upon an enemy area by means of chemical bombs, which are simply dropped and explode either in the air or upon contact. Two types of tanks are in use — the sprinkler, from which the liquid agent is discharged under pressure; and the spray type, from which the chemical runs out in a stream and is broken up by the air stream of the fast-moving airplane. It falls upon the target in the form of an enveloping spray or mist.



The spray attack is for low-altitude gas dispersing. Chemicals run by gravity from tanks under wing. The slip stream blasts them to drops of varying size. Big drops fall fastest, small ones slowest. Thus a cross wind spreads a wide swath of contamination

When the sprinkler type is employed in an attack, the liquid is forced backward out of the tank by a propellant, usually carbon dioxide gas, at a speed roughly equal to the air speed of the plane. This makes it fall straight down in large drops about the size of rain drops, and little vaporization occurs until it hits the ground.

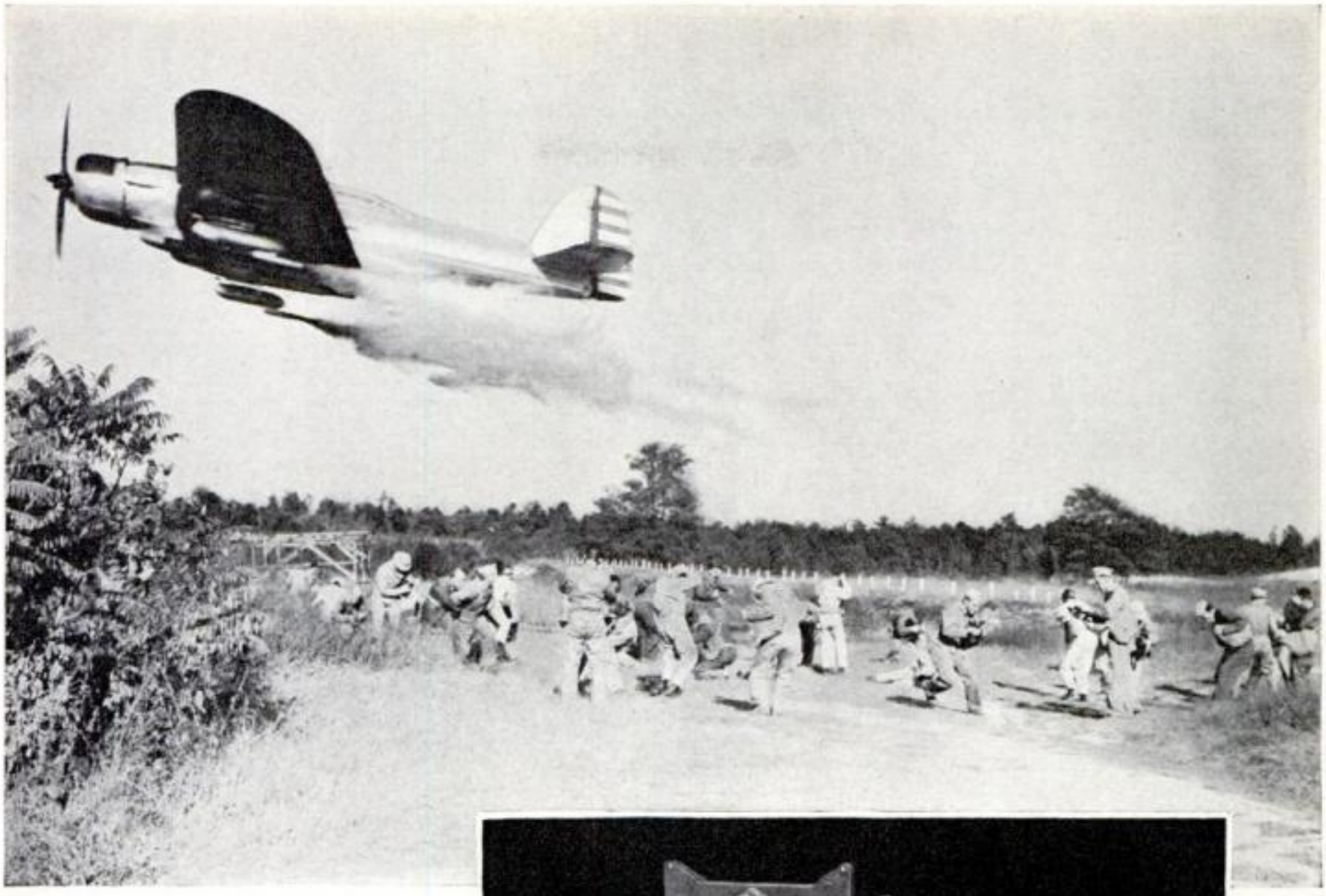
The principal disadvantage of the sprinkler method of disseminating gas from airplanes lies in the fact that it is difficult to predict where the drops will fall, for the fall depends upon the speed and direction of the wind at various levels. Under favorable air conditions at night it should be possible to hit a target such as a large industrial district from altitudes up to 10,000 feet. At altitudes of 2,000 feet it will not be difficult to hit a small area such as a railway terminal or junction.

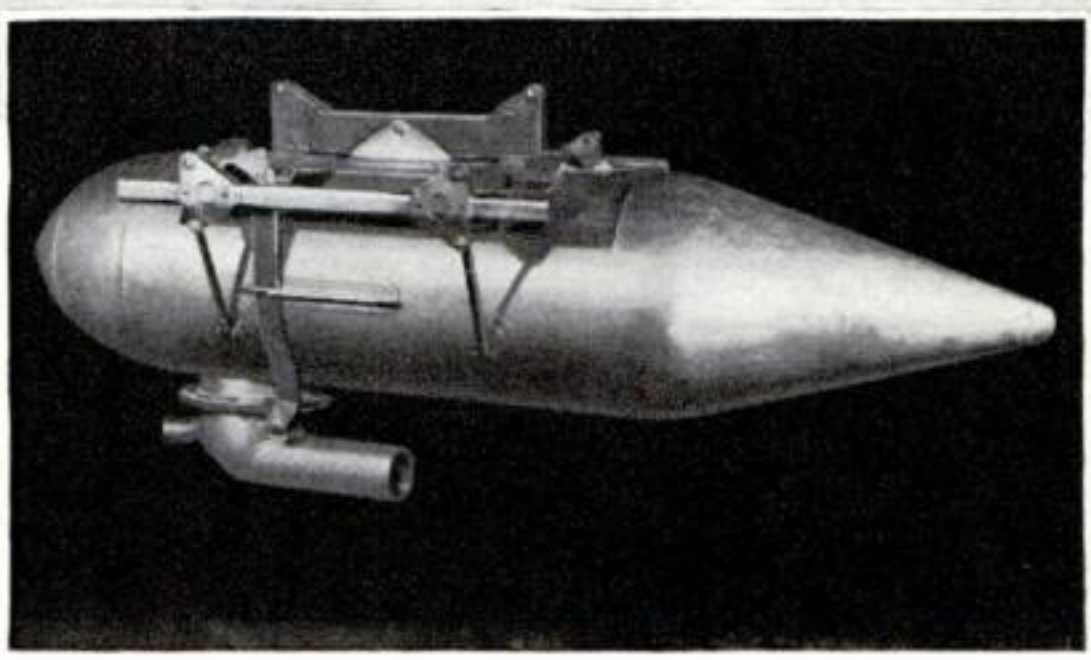
It is estimated that from 1,000 feet with an average wind velocity of 30 miles an hour, an area 1,000 feet wide by 4,000 feet long can be covered by about 700 pounds of chemicals by sprinkling. The width of the area covered increases with the altitude from which the liquid is dropped, and also with the wind velocity. The greater the area covered, however, the less concentration on the ground.

The sprinkler-type tank is comparatively heavy and cumbersome; is suitable only for medium and heavy bombers. On the other hand, the spray-type apparatus, which is the standard means of dispersing chemicals from the air and is the most effective means of chemical warfare, is simple and light. Equipment for a light bomber consists of four streamlined tanks, each holding about 22 gallons and weighing approximately 50 pounds empty, fastened to racks underneath the wing. When the discharge line is operated in flight by electrical means controlled by the pilot, the chemical runs out of the tank and is broken by the air blast into a finely atomized cloud of droplets, which fall to the ground forming a rectangular pattern. The larger drops fall almost underneath the plane, while the small ones are carried farther down-wind. The length of the pattern is the distance that the airplane has traveled during the time the tank was being emptied. The higher the airplane and faster the wind, the wider the pattern. A wind at right angles to the line of flight gives a wider pattern than a parallel wind.

The British believe, according to one of their official gas-defense publications, that "spray attacks from a height may be delivered by the enemy at such a distance from the target that the aircraft concerned can neither be seen nor heard." There is no doubt that chemical spray is a practicable and powerful weapon at high altitudes. But it was developed primarily for low-altitude attack, and is most effective at from 75 to 150 feet.

At these altitudes, with a wind speed of from five to 15 miles an hour, an area about half a mile long by about a quarter mile wide may be covered by one of the four tanks. One airplane, releasing two tanks at a time, generally covers about a mile. The entire area thus covered is contaminated by





Light-bomber, low-altitude, spray gas attack. Right, the liquefied-gas container. When pilot opens a valve, the liquid flows by gravity into the nozzle below. The wind does the rest

vapor and droplets of chemical. Since the agent has been finely atomized, evaporation is rapid by this method, and the immediate concentration of gas in the air is high. The concentration of mustard vapor obtained by spraying, for example, is greater than that obtained by any other weapon, the effects are produced more quickly, and the toxic possibilities of the agent are more completely realized. The vapor at the time of spraying and for some time afterwards will affect all personnel in the area actually contaminated, and even for a distance down-wind at least equal to the width of the area sprayed.

The persistence of gas thus discharged upon an area, however, is much less than that of the same gas disseminated by means of the airplane bomb. Where contamination for long periods with mustard-type agents is required, the chemical bomb dropped from planes will be found more useful than the spray. Three such weapons are now available to the United States Army—the 30-pound standard bomb, the 30-pound thin-case bomb, and the 100-pound thin-case bomb.

In searching for a more effective bomb, it was found that a tin can filled with mustard gas, and dropped from low altitudes at high speed, gave excellent dispersion of the liquid mustard. Such a device, however, had a number of faults and there has been developed the thin-case bomb, nearly 80 percent of which is active chemical. When dropped from high altitudes a bursting charge fired by an instantaneous impact fuse is used to prevent the bomb burying itself in the ground and so losing much of the mustard. When dropped from low altitudes on hard ground the bursting charge is not used, and the dispersion of the gas is obtained by the thin-case bomb breaking up on contact with *(Continued on page 216)*

You Build 'Em— We'll Bust 'Em

That's the Taunt of a Team of Tank Drivers Who Try to Show the Engineers What's Wrong with Their Tank Traps

RALEIGH BOAZE of Danville, Va., is 22 years old. Three years before he arrived at this hoary age of discretion, he went out one night in a brand-new car his dad had given him, opened her up wide, and somehow tangled with the tail end of a cargo trailer. He escaped without a scratch, but next day the junk man took the car away for $25. That taught Raleigh a lesson. Today he does his driving in an Army tank, built for durability.

The fortunes of war, operating through the personnel officer, have found a peculiarly fitting niche in the Army for Private Boaze, since he was mustered into service with the Virginia National Guard.

He is one of eight young tank soldiers assigned to the Army Engineers' Replacement Center at Fort Belvoir, Va., who spend the days dashing their battered battle buggies hell-bent into and through the most ingenious tank traps that can be devised by the pioneer platoons in training.

Sometimes it's a 20-foot crater, eight feet deep, blown with dynamite; and the idea is to jump it. More often it's a complex contrivance of oak, hickory, ash, and pine logs cut in the near-by woods, designed to throw the hurtling mass of steel from side to side, slowing it up, and then hoisting it up, pitching and careening, until it rests crazily astraddle of a log, with its tracks turning helplessly in thin air.

Whatever the obstacle may be, the tank comes charging in at the top speed it can obtain in a 200-yard run, seeking to crush what it cannot climb. All tank drivers pride themselves on being reckless, crazy, hard drivers, figuring it's the best way to

THE BUILDERS: Negro troops in training at Fort Belvoir, Va., construct an obstacle which (they hope) will stop a tank. They do the job in 90 minutes flat

THE BUSTERS: Raleigh Boaze (at front, left) matches coins with one of his mates to see which will buck the pioneers' trap

"FOR THE PRIVILEGE OF RISKING MY LIFE"

Husky shoulders strain to roll a heavy log in place in front of a ramp-type trap. A hurdle like this, especially if laid diagonally to the path of approach, will spoil the tanker's aim at the main obstacle

avoid the upsets and other troubles that haunt the timid. But this kind of work is something special. An ordinary driver might bang at a tank trap once or twice in a real battle, but Raleigh and his mates do it as many as eight times a day.

One of their forerunners last year hit so hard that he cracked a few vertebrae. Another nearly split his chin in two. Temporary knockouts are commonplace. But still it is their idea of fun. There nearly always is an argument about who gets the first chance at a run. They flip coins for it. The winner gets the tank.

This trap testing has two purposes. One is the practical business of developing new methods of building obstacles out of materials readily at hand. In this, much progress has been made, the skills being carried on by a detail of noncommissioned officers who coach each new platoon in a different scheme of building. When this work first started the tanks always went right through the obstacles. Nowadays they are hung up more often than they get by.

Perhaps of even more value is the zest which the spectacular testing gives to the strenuous job of building the obstacles. When men know that they have just an hour and a half in which to build a strong structure of heavy logs, and then a tank will come roaring down to try to break their handiwork, they go to work like a football team in a tied game.

Photos by
WILLIAM W. MORRIS

Driving a post with a pneumatic hammer. Colored troops make good pioneers and enter heartily into the game of trying to block the drivers of the hell buggies

Outside the Air Corps, the Army probably has no more dramatic show than this business of building obstacles and breaking them. The day we were at Belvoir, three recently inducted platoons of Negroes from New York City were getting their obstacle lesson; and it was more like a holiday than heavy work. Colored troops are best at this kind of job. There always are some big brawny fellows among them, who enjoy letting loose their muscles and setting a pace.

The first platoon was the best among them, and certainly one reason for that was Richard Sanford, whom his mates called Sandy. Black as midnight, strong as an ox, lithe as a panther, Sandy handled a 20-pound maul as easily as a bandleader's baton. They were pounding in heavy stakes, two

Ready for the test: a sawbuck trap with log hurdle. Below, the steel juggernaut hurtles across the barrier and hits the trap head-on

The trappers win! Jammed high on the log ramp, its treads pawing the empty air, the tank is an easy prey for hypothetical antitank guns hidden near-by

men to a stake, to hold vertical the piled logs in the side of a crib. Sandy was swinging away easily, 60 strokes to the minute, and he wore out three partners before he even had to stop for breath. That whole outfit was full of yelling, grinning enthusiasm.

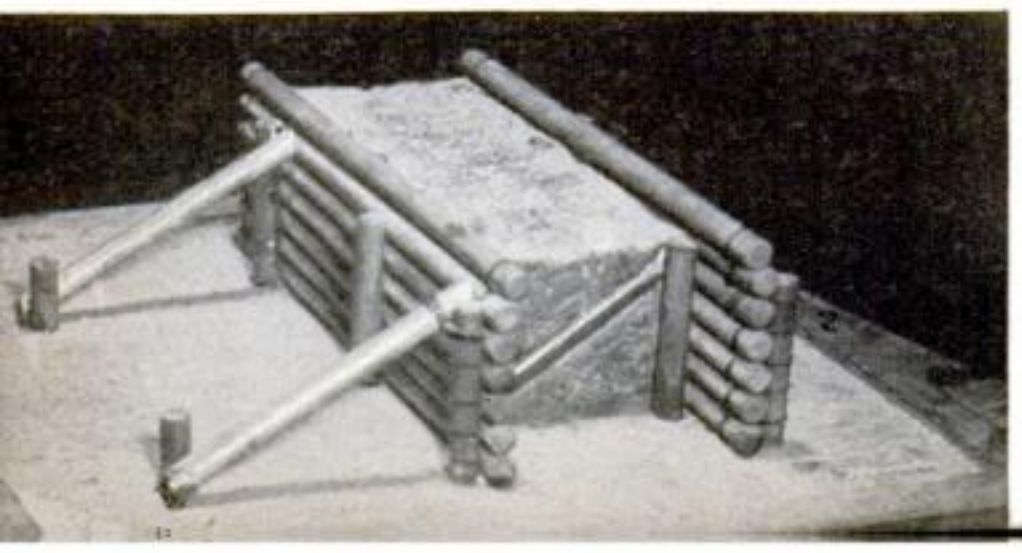
The obstacle was finished in 90 minutes, across a dead-end road cut back in the forest. First there were two diagonal barriers, about two feet high, of logs heavily staked—so set as to start the tank careening and slow it up so that the main barrier could go to work on it.

The main barrier was a crib, nearly four feet high, of logs set in the shape of a triangle, each wall heavily staked on both sides to hold it vertical. The stakes were really heavy posts of varying length, sticking up above the walls of the crib. That is, one post would stick up perhaps two feet higher than the ones on either side. Three heavy logs sloped up to this crib, the center one in a higher plane than the ones on the sides. The idea of these arrangements was to try to catch the tank so that it rested on its belly, rather than on its tracks.

Now Raleigh's tank came roaring down the road, all buttoned up, moving up to second, third, fourth gear. It reeled crazily as it hit the first barriers, but was still going strong as it struck the sloping ramp. The nose of the tank heaved high, then crashed downward. It struggled from side to side, first this track catching and then the other. But in a moment it keeled over to one side, caught

"What'll you bet?" Private Booze lays a wager with Richard Sanford, strong man of one of the pioneer platoons, that he can take his steel chariot across a newly built obstacle

TWO TYPES OF TANK TRAPS are illustrated by the models below. At the left is a crib made of log walls and earth filling, presenting a sheer wall and braced strongly on the side opposite that from which tanks will come. At right is a ramp designed to catch a hell buggy on its belly, treads in air



on a high post, its traction completely lost.

It was bedlam around there. Those engineer troops were cheering like a mad football crowd. Several of them had laid bets with the idle tank drivers, and they had won their bets.

One of the tank drivers leaped to the top of the pile, unbuttoned the front armor of the tank. They take this business gaily. The drivers scorn any special equipment save a safety belt over the thighs and a regulation helmet. But there is nothing casual about the way one always leaps to look inside the tank, after the crash.

As the front opening hinged back, Private Boaze's head and shoulders appeared. He stood up, struck a mock dramatic attitude.

"Foiled by the fickle hand of Fate," he cried. There is no doubt these kids see themselves glamorously, and are filled with bravado. They are entitled to be that way.

The troops had stood back, under orders, by the edge of the woods, during the tank run. But now they were milling all around, shouting triumphantly. Sheer ecstasy covered the face of Sandy as he swung his maul, knocking the props out from under the stranded tank.

Land mines form the most effective barrier against tanks; when a battle wagon hits and detonates one of these deadly packages of explosive, it will almost certainly be stopped, its tracks broken. Then it becomes immediately an easy prey for tank-destroyer elements concealed near-by. But the mines must be laid over wide areas, or the tanks will be able to find a place where the explosives aren't thick enough.

Road obstacles are built in two main types—the crib, which is often filled with dirt or stone to make it solid, and may be built either as a log ramp or as a wall; and the sawhorse, which is connected by a series of half ramps, high in the middle and held high at the far end with cross braces like the end of a sawbuck. In every case of obstacle construction the engineers must take advantage of natural features of the terrain, which sometimes provide more effective barriers than man-made traps. The progress of a light or medium tank is definitely stopped by soft, mucky soil with firm bottom not less than 20 inches from the surface of the ground. Existing theories as to the effectiveness of natural obstacles, however, probably will have to be revised somewhat in view of the Japanese successes in the rice fields and jungles of Malaya.

Another definite tank barrier is a properly constructed ditch; it must be bridged or filled before passage is possible. One of the best methods of building an obstacle of this type has recently been developed at Fort Belvoir, and successful experiments have also been made at Fort Knox, Ky. Engineer troops drill a line of holes, using an earth auger with a 16-inch bit, five feet deep on five-foot centers. Each of these holes is charged with a 50-pound case of 50-percent dynamite, TNT, or nitrostarch. In exploding these charges the best results have been

Untrapping a stranded tank can be a job in itself, but it's pleasant work for Sandy, seen at the right happily swinging his maul as he knocks the props out from under the helpless land battleship stuck on the ramp

The cheering section shouts gleefully as a tank comes to grief on the pioneers' handiwork. The colored troops are as enthusiastic as the crowd at a hard-fought football game

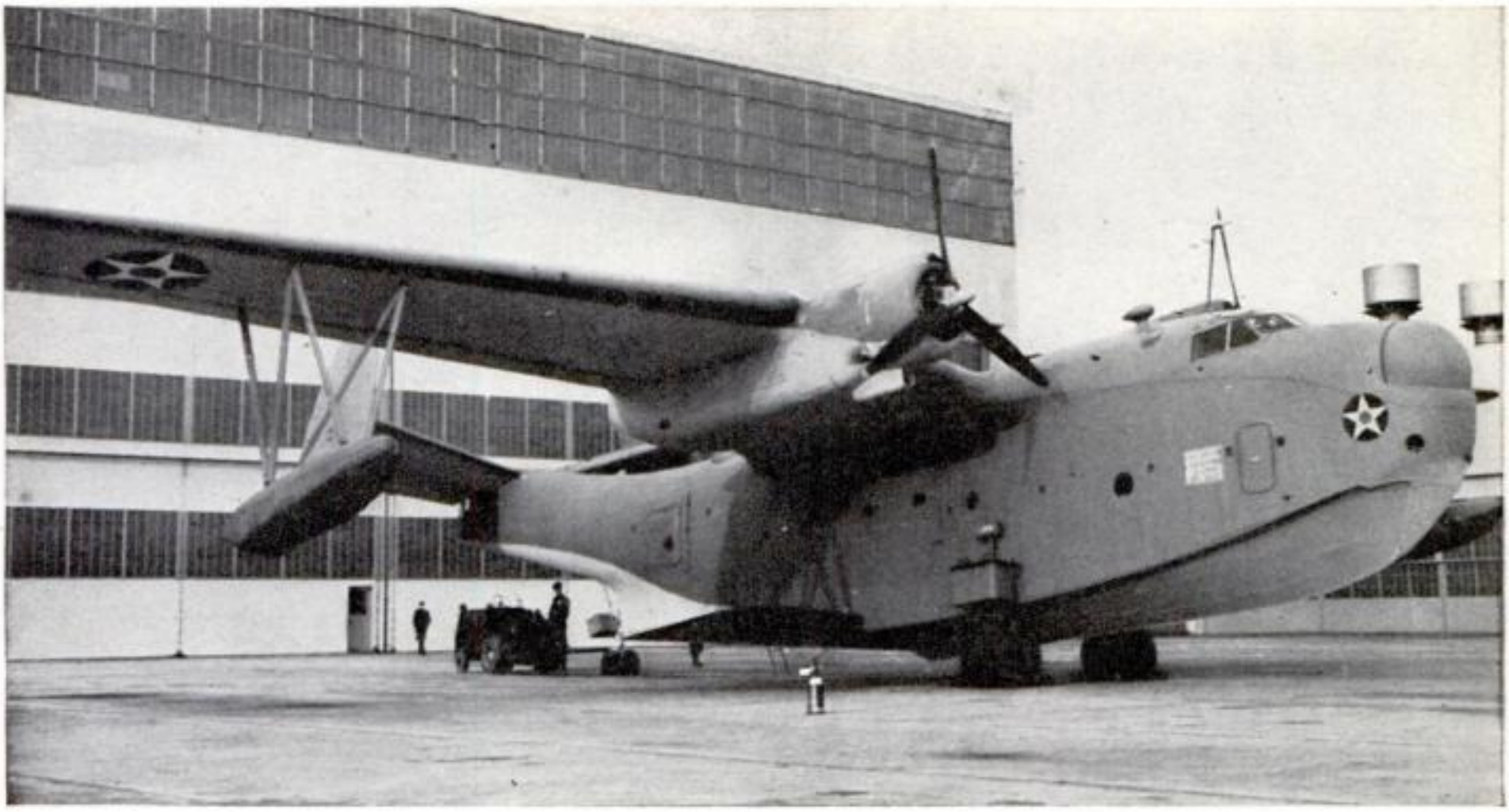
. . . while their tanker opponents show a similar sporting spirit. Private Boaze (below) calls himself a guinea pig in the science of war, and keeps one of the rodents as a mascot

obtained by connecting the holes in series, with two electric caps in each package of explosive. The crater in every case was from seven to ten feet deep, with steep sides, and cleaner than a control crater made by detonating 150 pounds of explosive in a ten-foot hole. One of the principal advantages of this system of ditching is its rapidity—engineer officers estimate that in four hours a trained crew of 11 men, equipped with one earth auger, can prepare one hundred yards of ditch. Log hurdles should be placed in front of the ditch to throw the tanks out of balance before they hit the ditch.

The construction of all obstacles designed to stop tanks must be extraordinarily stout, for a tank weighing, say, 60,000 pounds and traveling at 25 to 30 miles an hour, rams into a log barrier with a terrific impact which involves approximately 2,500,000 foot pounds, or some 2½ times the kick of a 14-inch railway gun. Such barriers must also be built in depth, for a tough, determined tank driver will nearly always pass the first obstacle of a series, which he can strike with full momentum, and can be stopped only when he has lost his sense of balance and his machine has been slowed down. Log hurdles, particularly if built of trees 18 inches or greater in diameter, and placed askew to the main line of the obstacle, have been found very effective in disturbing the driver's sense of balance.

Although all road blocks of the obstacle type are of limited usefulness, building them is a fundamental part of the knowledge of the Army engineers. Their principal value is against tanks operating in a confined space, such as a road between a river and a cliff, or a cut between high embankments. But nowhere is an obstacle really effective unless it is covered with fire from 37-millimeter antitank guns or 75-millimeter field guns. Once a tank is stopped or slowed down, it is an easy target.

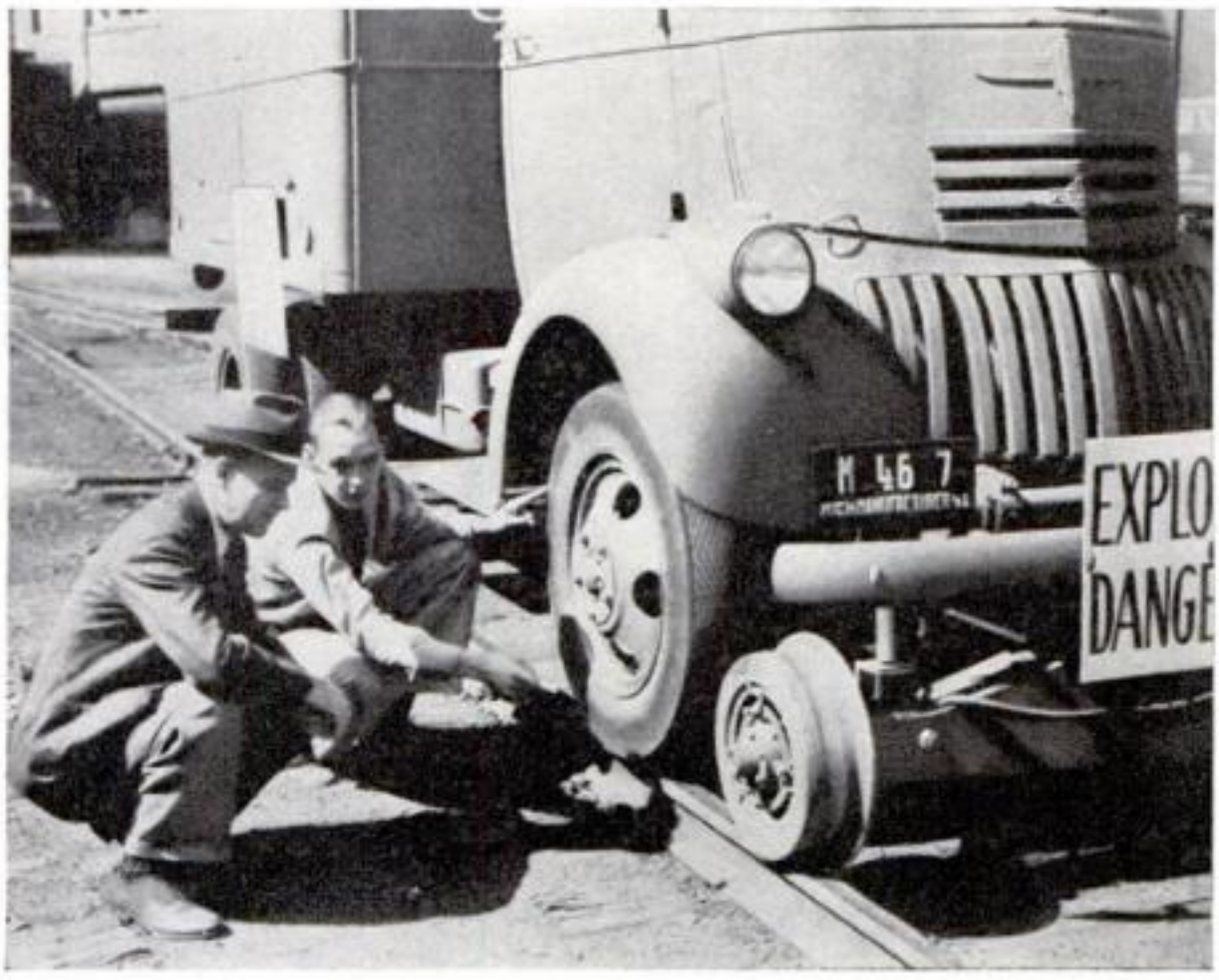
To the perspiring pioneers and the hard-driving tankers, the good-humored contests in the Virginia pine woods are an exciting game. But they have a more serious side. When, on some far-off battlefield, American troops meet the mechanized forces of the Axis, men like Sandy will build the traps to bag the tanks. And if they have learned to stop boys like Raleigh Boaze and his buddies, they won't have any trouble with the Japs and Germans.—HICKMAN POWELL.



Long-Range Navy Patrol Bomber Goes into Mass Production

A NEW and improved American patrol bomber, the twin-engined Martin "Mariner" or PBM-3, has gone into mass production for the Navy. Flying boats of this type perform the dual mission of scouting and bombing. Unlike smaller planes of limited range, they can be flown thousands of miles to distant combat zones. Recent models emphasize speed and fire power, enabling them to dispense when necessary with the protection of an escort of fighters. War reports from the Far East tell with increasing frequency of enemy attackers shot down by bombers. With the sea war spreading over an ever-widening area, calling for more and more patrol, scouting, and convoy work, the long-range patrol bomber plays an important part in naval operations.

Rubber-Tired Trucks Carry Explosives on Road or Rails



Flanged steel wheels guide rubber tires when the truck is run on rails

TRAVELING on road or rail, rubber-tired vehicles now safeguard transport of explosives at U. S. arsenals and powder depots. Flanged steel wheels, raised or lowered from the driver's seat by a hydraulic ram, guide a car on the tracks, while the tires cushion a 3,000-pound load of explosives against jolts. According to the Detroit, Mich., maker, the hybrid machines may also serve as ambulances, passenger carriers, and locomotives. Tests indicate six times greater tractive power than with steel wheels alone, in addition to the increased freedom from shock afforded by rubber.

U. S. Army pilots combine business with pleasure by playing a new card game that refreshes their minds on the looks of friendly and hostile planes. At right is a sample hand

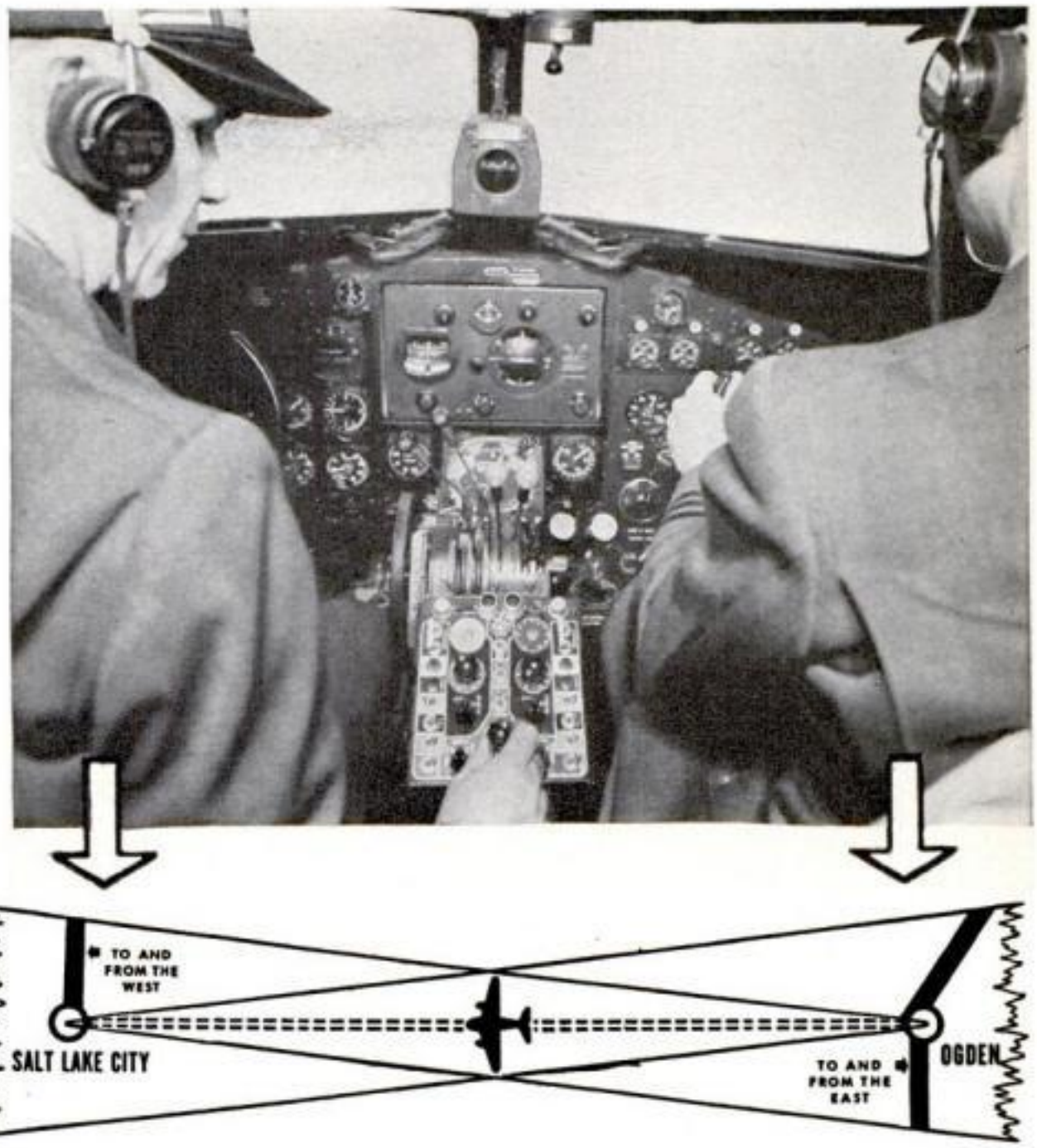
PILOTS PRACTICE SPOTTING WITH

Airplane Playing Cards

AMERICAN pilots recently returned from England have imported a novel card game played by members of the Royal Air Force. The game, devised to keep profiles of enemy and Allied planes fresh in the pilot's mind, is similar to rummy. Instead of the traditional suits, however, profiles of American, British, German, and Italian planes are printed on the faces of the cards. The object of the game is to match four different profile views (top, bottom, front, and side) of one type of plane and three views of another before the hand can be put on the table. If the pilot makes a mistake, he is penalized 20 points but if his suit is correct he drops out of the game until the next hand. The game is finished when one player is penalized 100 points. A full deck includes 52 cards and a joker. The joker has profiles of four different planes and can be used as a substitute card. Comparison charts are included with each deck to enable players to check their mistakes. As in regular playing cards, each card has its value printed in reduced size in corners, for identification when held in the hand.

Double Radio Beams Guide Planes

POWERFUL "double-track" radio beams, transmitted from radio range stations 30 miles apart, now make it possible for United Air Lines planes to double-check their approach to Salt Lake City, Utah. As a plane nears Ogden, Utah, where the first transmitter is located, one pilot tunes his radio to the frequency of the Ogden range while the other pilot tunes to the frequency of the Salt Lake range. The two beams, one received by each pilot, and both exactly "on course" though traveling in opposite directions, thus provide a double check on the plane's course, enabling the ship to come into Salt Lake City over a considerably lower terrain than that over which the former course led. Pilot and copilot have separate radio controls.



Pilot and copilot tune to separate radio beams from the two cities. The double-check system permitted rerouting the trip over much lower terrain

An electric pump powers the portable water sprayer, which a reserve tank serves if the regular water supply is cut off

Incendiary-Bomb Fighter Carries Water Reserve

TO COMBAT fires caused by incendiary bombs, a California inventor has recently devised a portable fire-fighting apparatus that will operate efficiently even though its water supply is cut off. The unit is normally supplied with water from a regular house outlet, although it can be operated by drawing its supply from a 20-gallon tank mounted on the hand truck. Pressure is maintained by a centrifugal pump mounted at the outlet of the reserve tank. This pump is powered by an electric motor connected to 250 feet of wire. Although the apparatus was designed for a large plant, it can be used in any area where there is a standard electric supply available for driving the pump motor.

Rubber-Balloon Globe Puts the World in Your Pocket

At right is the balloon globe, deflated; above it is used to point out a war area

CARRYING the world in your pocket is no task with this balloon globe designed to keep you abreast of world events. The rubber balloon can be inflated by three or four lungfuls to a diameter of eight inches. The neck is then twisted and passed through a slot in the cardboard disk which is used as a base. The globe's scale is approximately one inch for 800 miles. To put the world back in your pocket, just pull its neck out of the slot in the base and let the air escape.

A Portable Postal Scale Aids Air-Mail Users

LETTERS of two ounces or less can be weighed by a pocket scale that fits into a small leather case when not in use. In operation, it is necessary merely to fasten one edge of the letter to a clip and hold the scale by a ring. The working parts are simple and there are no springs to stretch. The case is provided with two small stamp compartments. The scale is especially intended for users of foreign air mails, for which postage goes by the half ounce.

Sound Meter Helps Linemen Find Faults in Telegraph Cables

LINEMEN can easily find trouble spots in lead-covered telegraph cables by sliding a pick-up coil along a suspected cable and watching a meter which fluctuates over the faulty area. This new apparatus, an improvement on the tone and search-coil method, consists of a pick-up coil coupled to a small, sensitive amplifier. Instead of earphones to pick up the tone, an indicating meter registers the fluctuation. This new development is used as a supplementary method by the lineman after calculations of the approximate vicinity of the trouble are made by the main office. The main office then transmits tone through the faulty conductor to guide the lineman. The device was developed by Western Union.

Trooper Horton tells "Smarty" what is expected of him as a member of a famous bloodhound pack

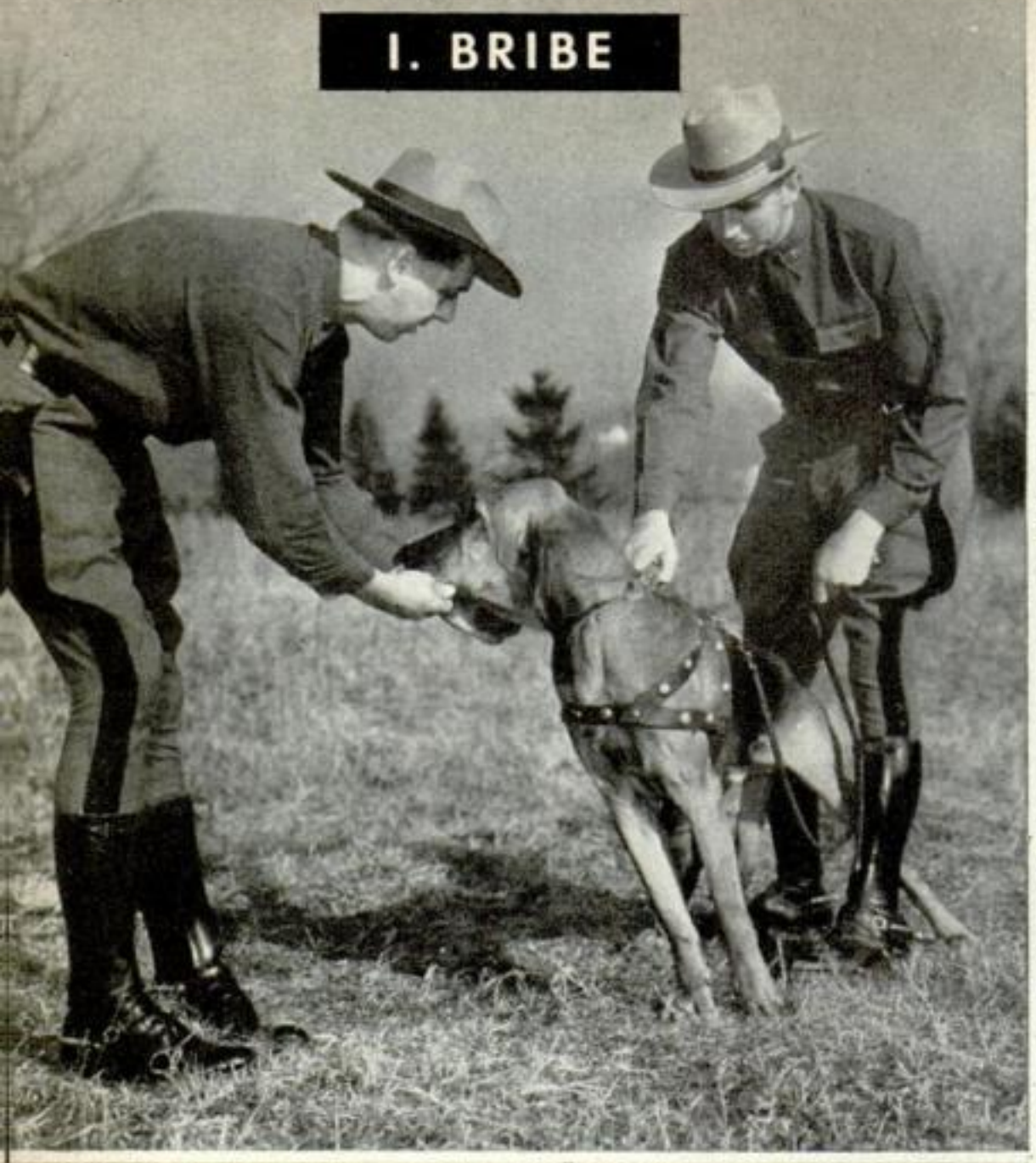
TRAINING BLOODHOUNDS

FOR POLICE WORK

TEACHING a bloodhound to hunt lost persons or trail criminals requires patience and understanding, according to Trooper William W. Horton, bloodhound trainer attached to Troop K of the New York State Police. Pictures on the two following pages show the methods used by Trooper Horton and his assistant, Trooper Robert Thomson, in initiating Smarty, a hand-picked pup, into the mysteries of police duty. Smarty is 18 months old, which is considered the best age to start training these intelligent animals to work.

OVER

1. BRIBE



TRAINING STARTS when Smarty is taken out into an open field and allowed to sniff a sizable piece of liver in the assistant trainer's hand. This gives him the idea that the assistant trainer is a good man to keep an eye on during the proceedings. Born and brought up at the barracks of Troop K, home of the celebrated New York State Police bloodhound pack, the doleful-looking Smarty was selected for training as the most intelligent pup in a litter

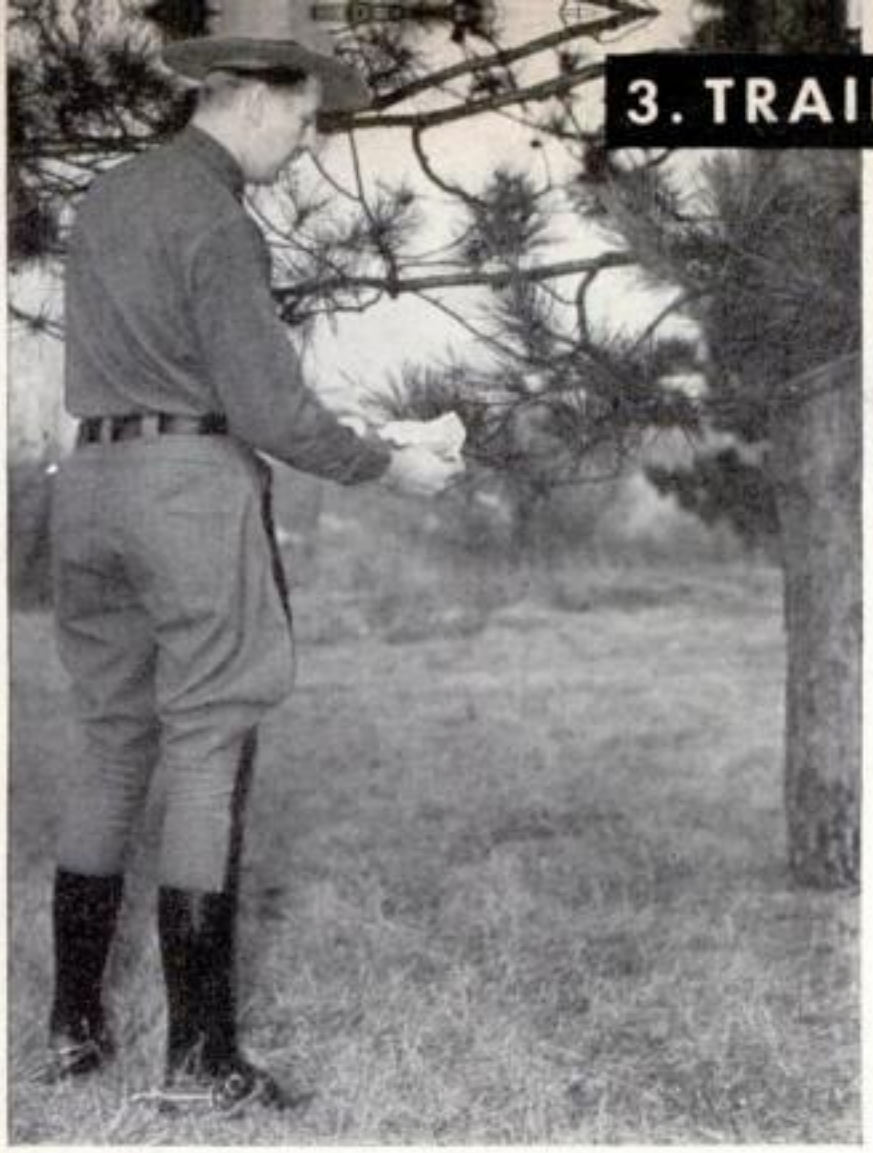
The assistant trainer, or "runner," runs about 50 feet away while the dog strains at the leash, thinking about the liver. Then he is allowed to bound after the runner and is given the meat. This is repeated and the distance is lengthened at every try

2. SCENT

A SWEATER or other garment belonging to the runner is used to teach the dog to follow a given scent. As Smarty sniffs it, the runner sprints away and hides. The hound, puzzled by the disappearance of the liver, gets the idea of following the scent . . .

. . . and strains at the leash until he finds his quarry crouching behind a stone wall. Strange as it seems, the scent of a human is stronger than that of any other animal, and no two people have exactly the same odor

3. TRAILING



Since wind sometimes blows the scent far to one side of the actual path followed by the quarry, the dog is not expected to stay on the trail, but just to go in the right direction

A PAPER TRAIL laid by the runner shows Trooper Horton when the dog is going in the right direction, as Smarty learns to trail with his man completely out of sight. No fooling around is allowed during training periods, and an intelligent pup soon learns not to mix business and pleasure. In this chase, the runner decides to hide in a deserted shed; he tacks a piece of paper on one side of the door as a clew for Trooper Horton. When Smarty unerringly tracks him down, a big fuss is made over the dog as shown at the right. Smarty sees that a good job earns him kind words—and more liver

4. AT WORK

HIS FIRST "CASE." After six months of this training, Smarty gets his chance to make good. In a light, plywood kennel, he is placed in the rear of a station wagon and goes out with the troopers to answer a call for help from a mother whose child has wandered away into the woods

Pajamas last worn by the lost child furnish the scent which Smarty follows to find the tot safe, asleep

Spiral Radio Beam

PREVENTS WAVE-JAMMING, IS SECRET

WAVE-JAMMING—the wartime practice of beaming a superpowered wave toward an enemy's radio sets to ruin reception—is defeated by a new-type radio system developed by John Hays Hammond, Jr., Gloucester, Mass., inventor and radio engineer. In addition, the Hammond system offers to radio more secrecy than a private telephone line on a dial exchange.

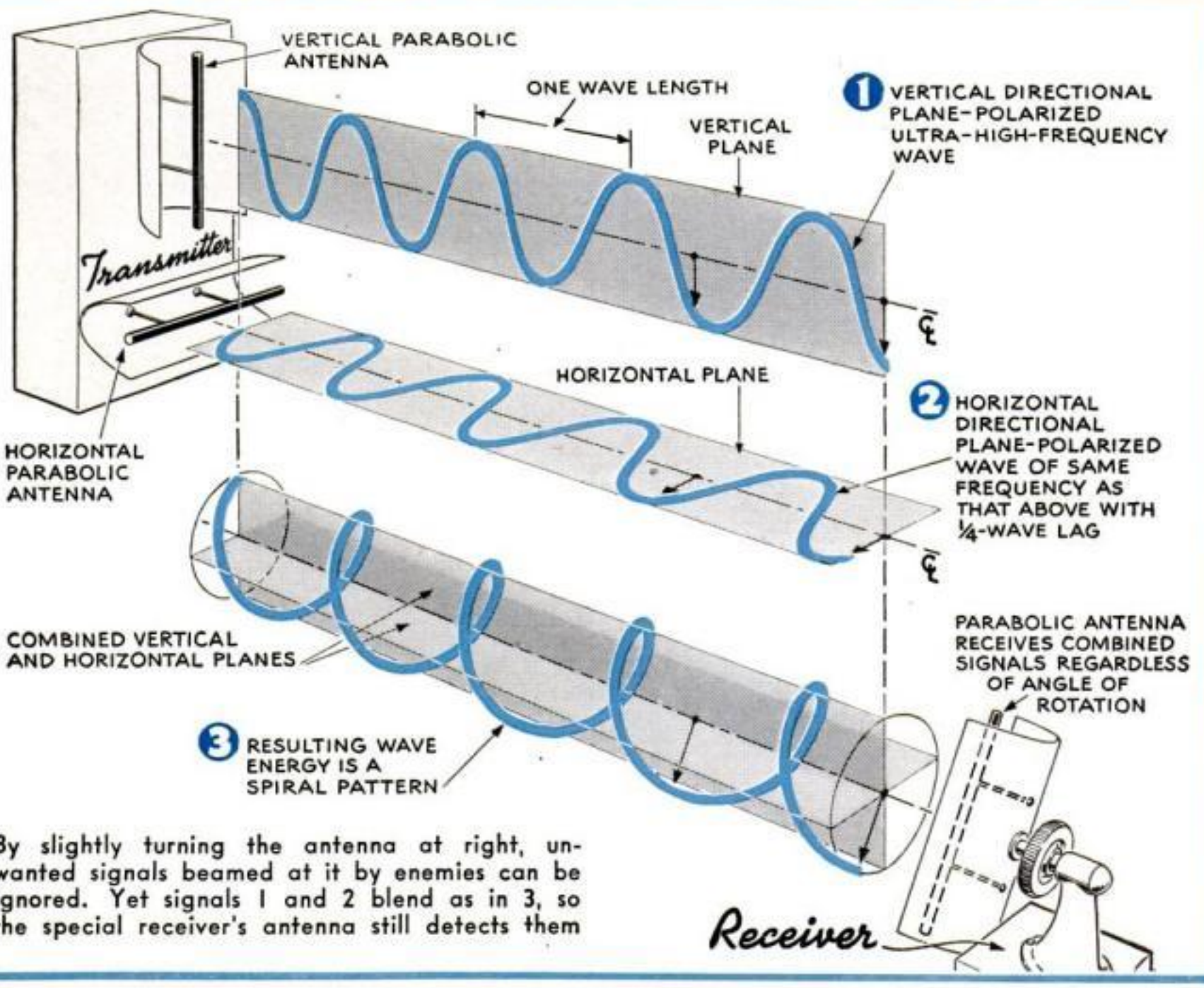
Designed with military adaptation in view, the system sends out messages by a novel method using a circularly polarized radiation. For radio purposes, this is created by suitably combining two plane-polarized waves of the same identical carrier-wave length.

The planes, called planes of polarization, of the parallel carrier waves are at right angles. So far they might be just two ordinary carrier waves going in the same direction at the same speed and frequency.

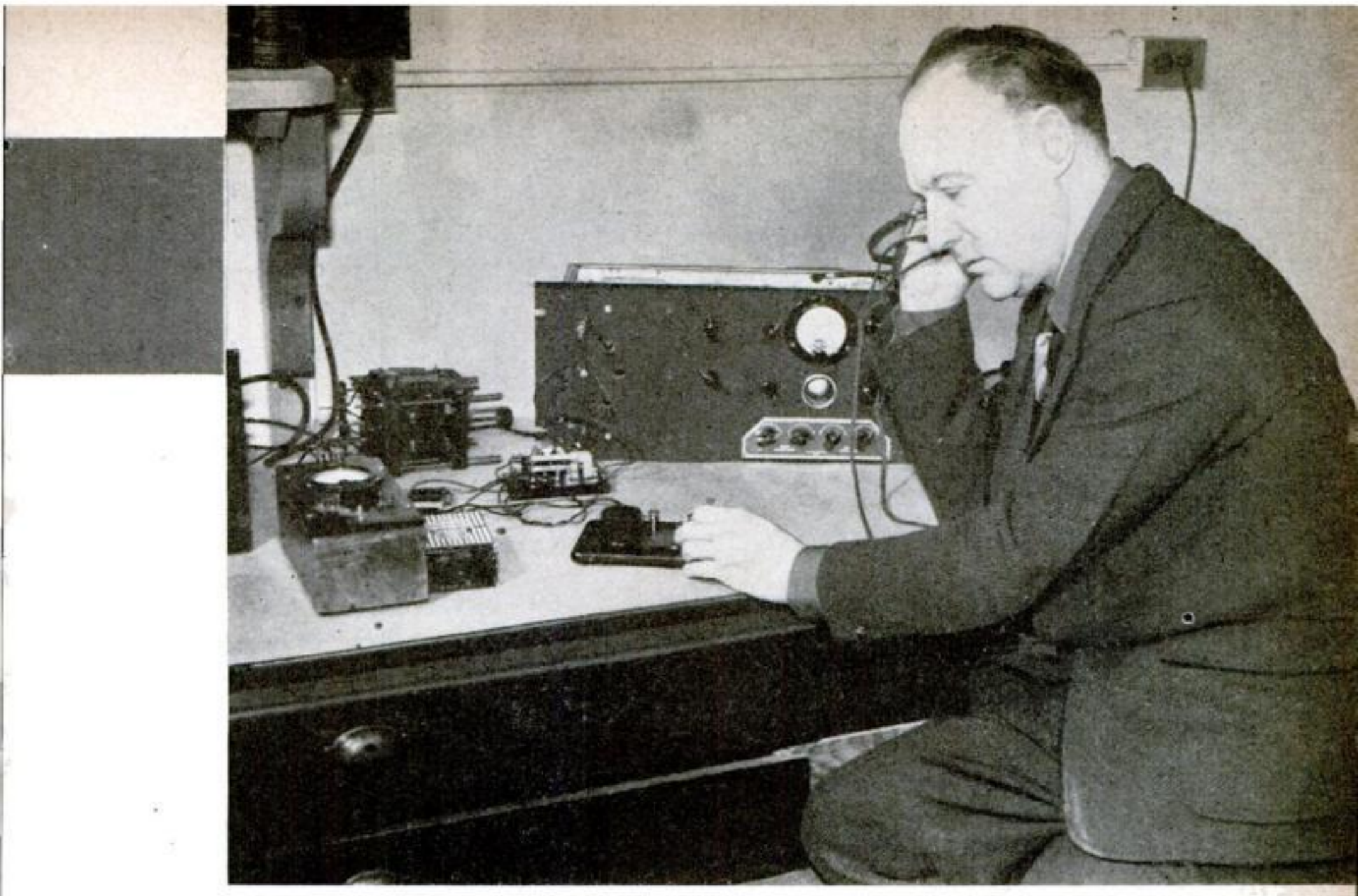
But here is the catch. One of the waves —either one—is delayed by the transmitter so that it leaves its individual antenna exactly a quarter of a wave length behind the other. Physicists can perform the same stunt on a beam of plane-polarized light, using a transparent plate which makes the light back-track slightly before going on its way. Another beam of light departing at the same instant in the same direction would reach its destination a quarter of a light wave ahead of its artificially delayed neighbor.

With the radio system, the delaying action occurs before the voice or other mes-

HOW THE POLARIZED RADIO SYSTEM WORKS



By slightly turning the antenna at right, unwanted signals beamed at it by enemies can be ignored. Yet signals 1 and 2 blend as in 3, so the special receiver's antenna still detects them



In his Gloucester laboratory, John Hays Hammond, Jr., tests part of his secret, jamproof radio

sage, technically known as the modulation, is added, so that although the waves are out of phase, their identical messages are in step.

This phase difference in effect produces a new type of wave, or a new energy form to the pair of waves. Again comparing it with a similar set-up of polarized light beams, the resultant wave now becomes circularly polarized. A simple way to visualize it is as a twisted tape, a corkscrew, or a spiral spring.

The antenna commonly used to broadcast or receive a plane-polarized, ultra-high-frequency radio wave is a bathtub-shaped device called a parabolic reflector, containing an insulated rod connected to the radio apparatus. The drawings illustrate such devices. To work at all, the receiving antenna must face the radiations coming from the transmitting antenna.

In the Hammond system, the two sending antennas are at right angles to each other. But as a result of the circular, corkscrew nature of their combined signal energy, only one receiving antenna is needed. Moreover, it may be turned at any angle on the axis of the directional beam without loss of signal strength in the receiver.

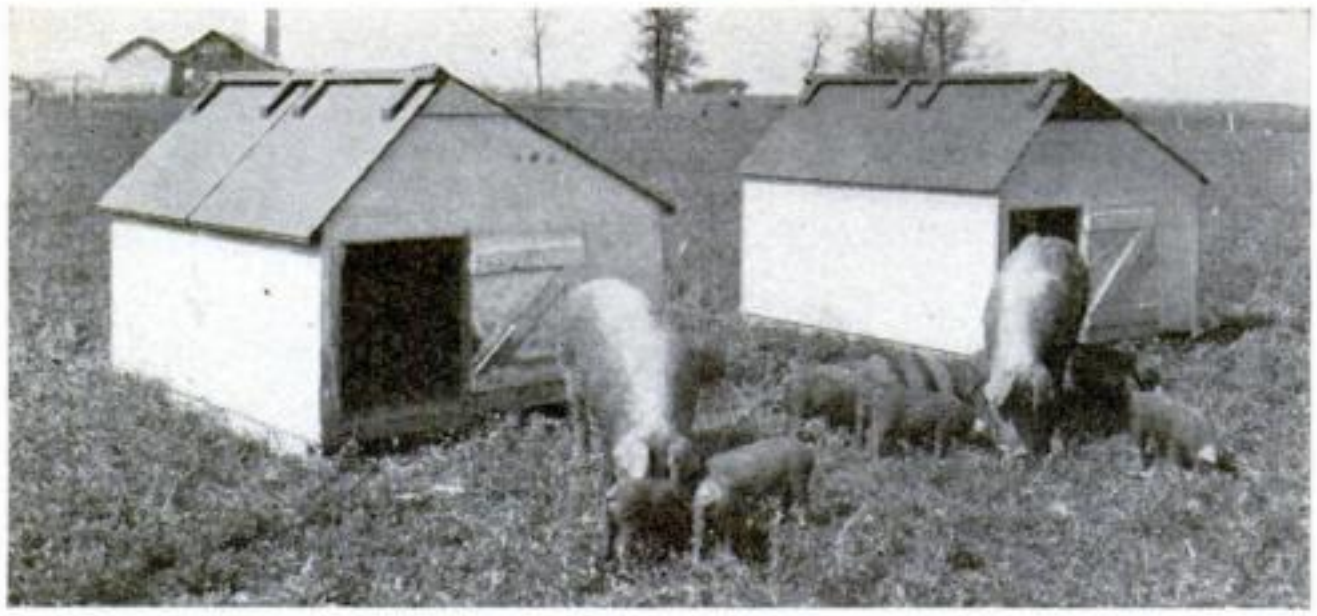
It is this feature that imparts the jam-free quality to the system. For an enemy signal of great strength beamed at the Hammond receiver can be ignored by simply turning the receiving antenna so that it is not parallel with the hostile transmitter's antenna. The system uses amplitude modulation (AM) of the new-type beam for carrying voice or other signals.

Similar secrecy and a different freedom from jamming are provided by a modification using two receiving antennas, and a transmitter and receiver with unique wiring hook-ups. With the modified arrangement, code signals can be sent by rapidly reversing the phase relation of the two plane-polarized waves with a telegraph key. The inventor calls it a practical type of phase modulation in which one wave serves as a standard for determining the relative phase of the other.

One phase relation then produces, say, a right-handed corkscrew representing dots, the other a left-handed for dashes. Ordinary receivers are not built for corkscrew reception and cannot therefore distinguish between two types of rotary wave motion. Thus they cannot distinguish between dots and dashes.

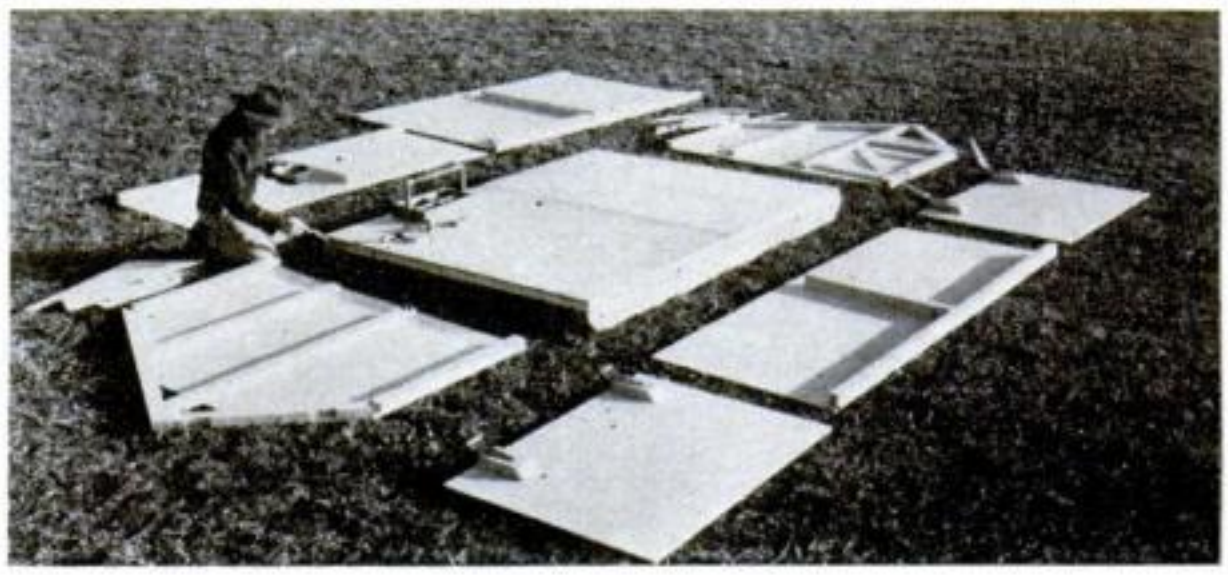
By a unique hook-up the modified receiver can be made not responsive to ordinary transmitters but efficiently responsive to the new-type circular polarized transmission, with a different response for the two directions of rotation. Therefore a system is provided with great freedom from jamming, since it cannot be operated by any of the transmitters currently in use.—SCHUYLER VAN DUYNE.

Prefabricated Houses Easily Put Up for Growing Farm Stock



Knockdown buildings occupied by hogs. They are suitable for other small stock on a farm

Prefabricated plywood sections laid out below for assembly. A house can be put up in one hour. The hinged roof permits easy cleaning



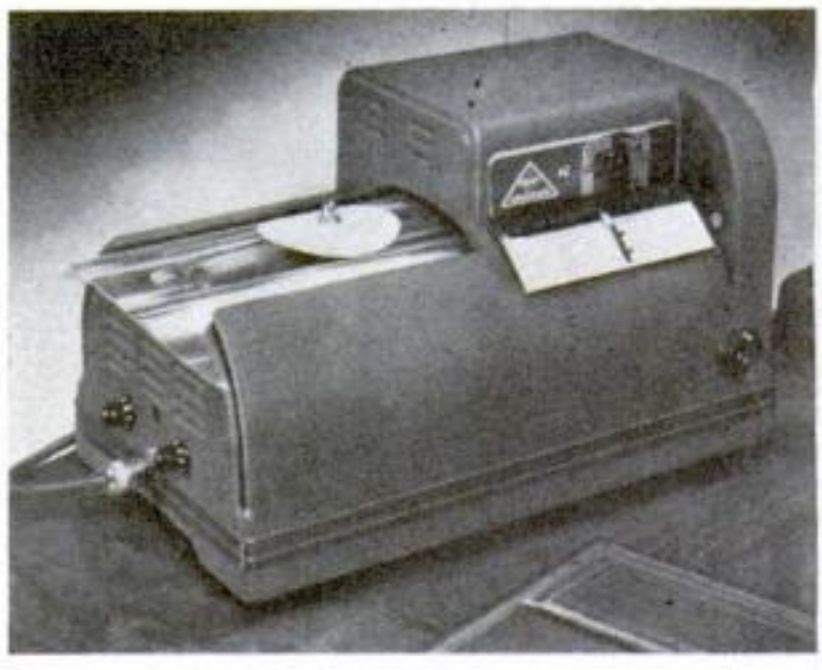
SMALL, prefabricated buildings for farm stock are being turned out to fill a need caused by the rapid expansion of food production for the war. Cut at lumber yards from blueprint designs originated at Purdue University, these knockdown, plywood animal houses can be assembled by the average farmer and a helper in an hour or so apiece. The completed buildings are light in weight, durable, and weather-tight, forming healthful, easily cleaned, floored units for growing stock. Each sizable shop-built section is reinforced, with plywood gusset plates giving additional strength at the joints. Floor dimensions are slightly under six by eight feet, and the height of the roof leaves ample clearance for small animals.

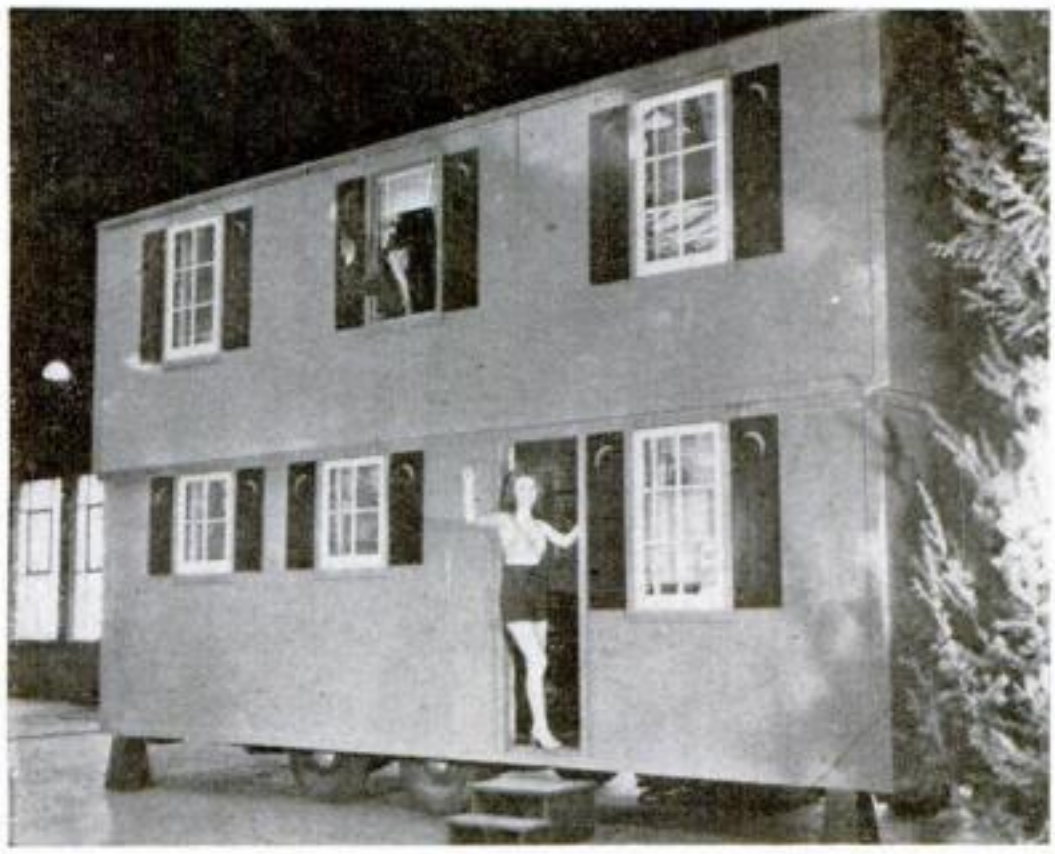
Office Recorder Puts Three Hours of Talk on Ten-Inch Disk

A NEW office recorder makes it possible to record three hours of conversation, dictation, and the like on a single ten-inch plastic disk. Paper-thin, the disk is curved on a special turntable while the machine is in use. Sound, picked up by a microphone or by connection to a telephone line or radio, is amplified to provide power for molding an actual image of the sound wave on the record material. Recording is done on both sides, each side good for 1½ hours. Disks can be stored in an ordinary filing case.

Sound recordings on thin disks of cellulose acetate may be filed in a letter cabinet

The compact unit at right records and reproduces sound. Flexible disks used on a curved table aid in saving space

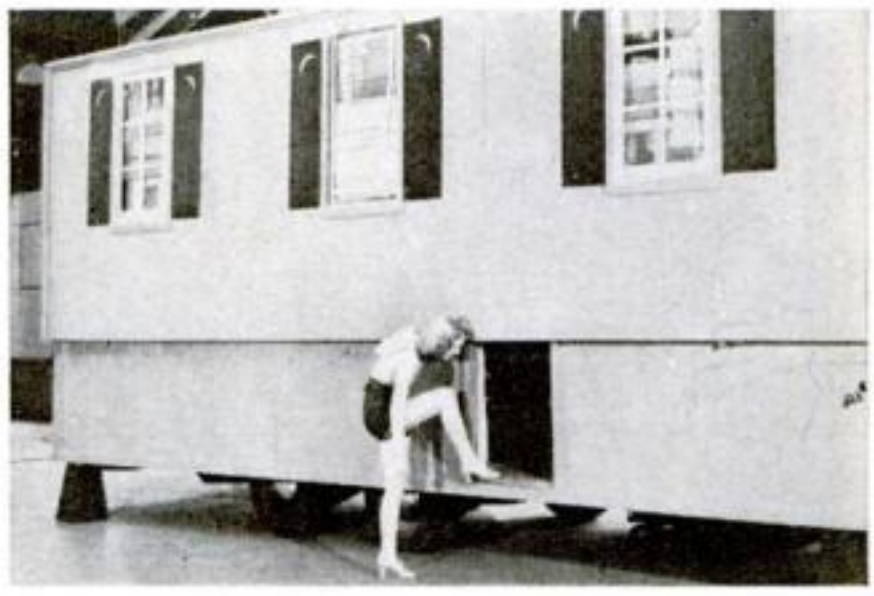




Expanded to its two stories, this trailer makes a vacation cottage or a home for a war worker where housing is scarce

New Two-Story Trailer Telescopes to Become Mobile Traveling Unit

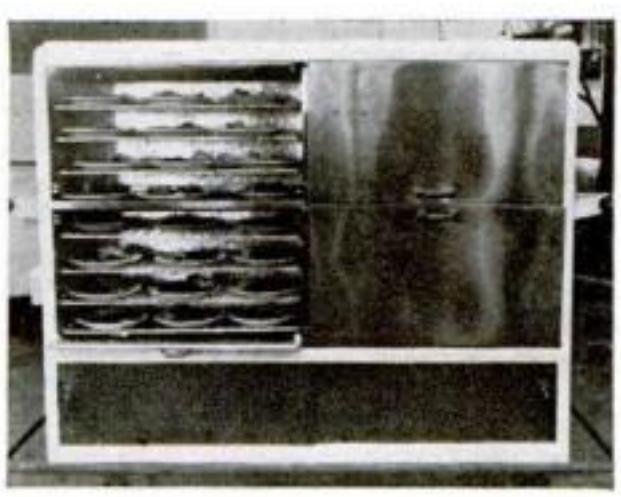
ONE of the solutions offered for the temporary housing problem is a two-story, telescoping trailer, which has equal possibilities as a comfortable vacation cottage. When the trailer is on the road, the upper floor is telescoped over the lower for mobility. Occupants of the house on wheels need only drive to their destination, turn a crank operating a pulley to raise the second story, and set up housekeeping. The top of the first-story ceiling serves as a floor for three small rooms upstairs.

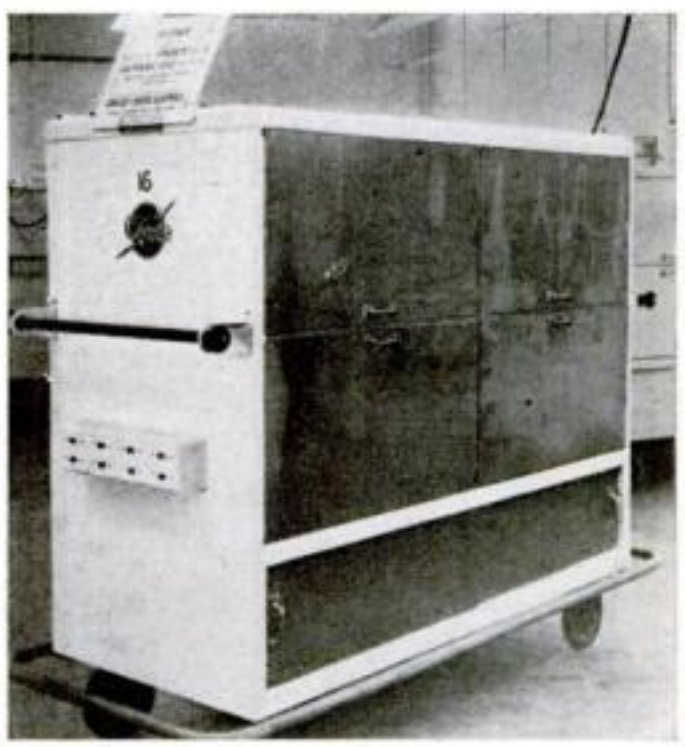


Easily managed pulley mechanism raises or lowers the second floor as the crank in the photo at left is turned. The upper story telescopes snugly over the downstairs for travel. Pads keep it from jouncing

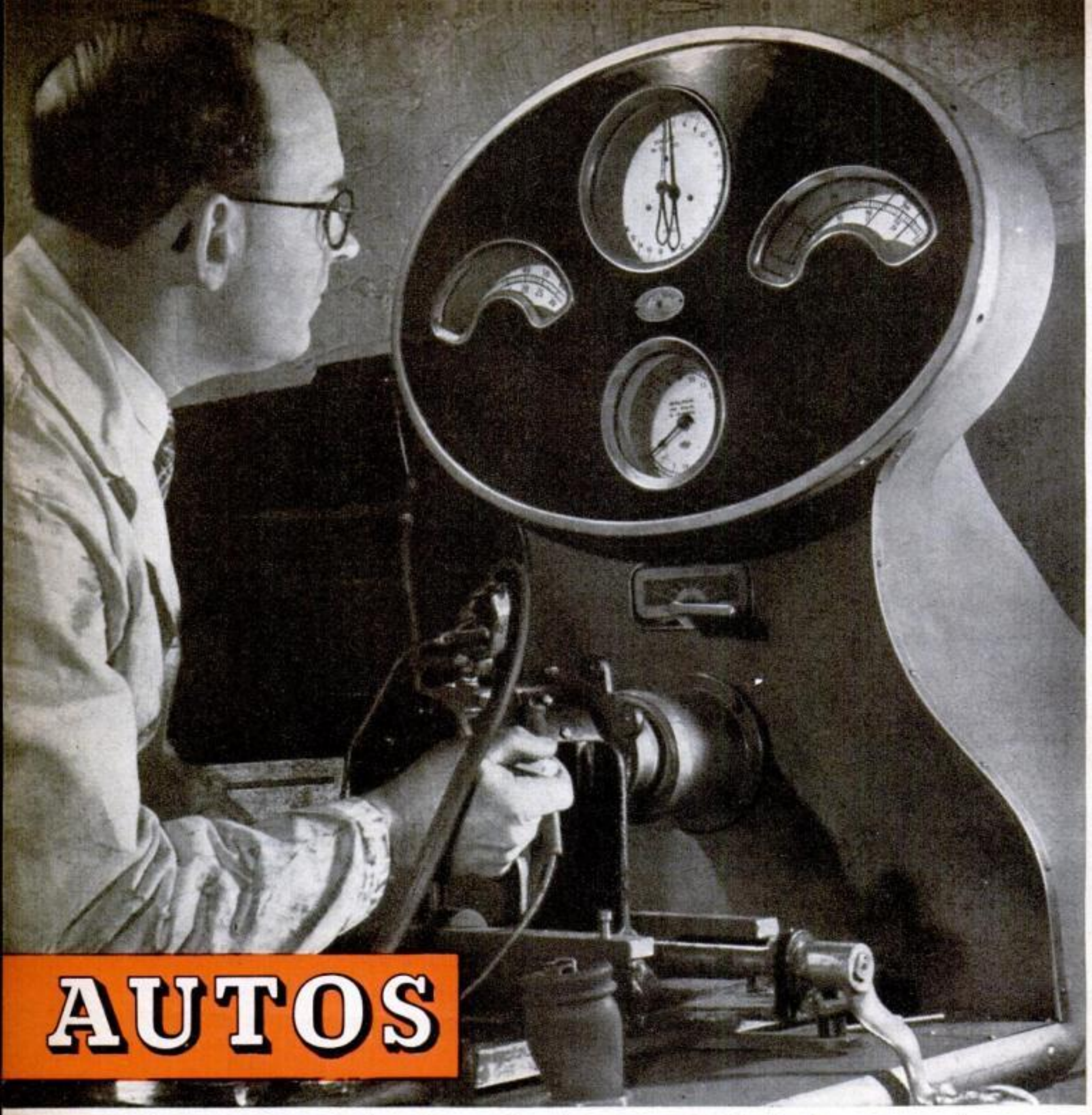
Rolling Restaurants Serve Quick Hot Meals in Plane Plant

FEEDING workers on the war-plant assembly line is a speed-up process which the Cessna Aircraft Company has developed to a fine point with a rolling cafeteria designed to its specifications. Mealtime has been cut more than half, permitting shifts to knock off earlier, food cost lowered by central preparation, and palatability improved by electric warming that keeps lunches piping hot right up to eating time. The restaurant wagons are heated in the kitchen, loaded with four-course trays, and dispatched to plant destinations where they are connected to electric outlets to await the lunch whistle. Each is capable of serving 100 meals and is accompanied by a coffee dispenser.





Four-course lunches are served piping hot from this restaurant wagon to cut mealtime and help speed war output



AUTOS

Bench-testing a generator, above, the expert's real aim is to extend the life of someone's car battery

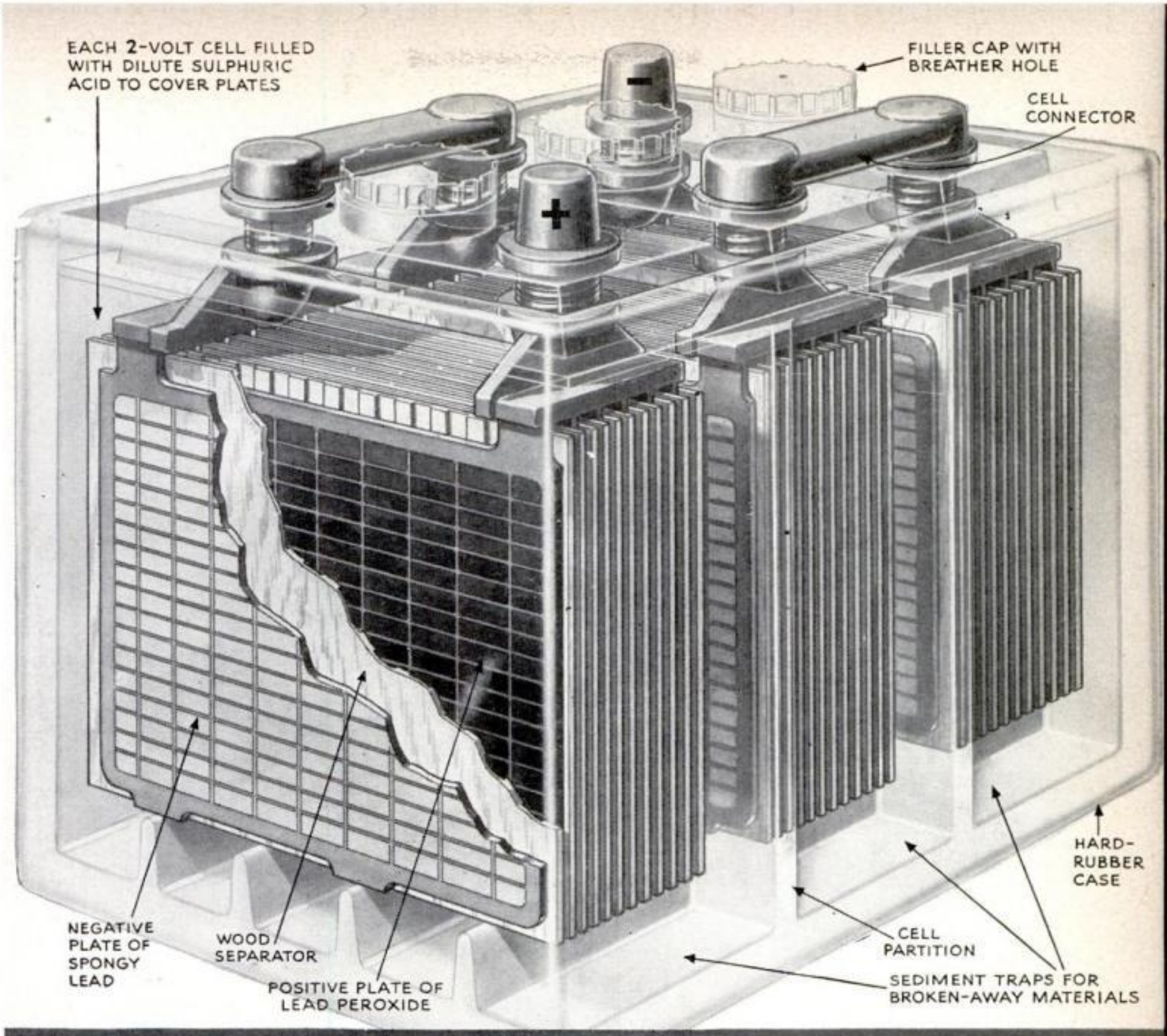
Longer Life for Your CAR'S BATTERY

By SCHUYLER VAN DUYNE

WHEN an automobile battery goes dead, more often than not it's a case of murder. In this once most wasteful of nations, few car batteries lived out their allotted years. They were starved, worked, shaken, scorched, or crushed to death in a sort of mass slaughter.

Understanding how a battery works will help you appreciate the importance of battery care. It is not especially complicated. It has three basic "active" parts, two of them sets of metallic plates, the third a liquid. One of the sets of plates is lead, the other lead peroxide. The liquid is dilute sulphuric acid. The three elements are inside a hard-rubber cell and there are three such cells.

You may find six, seven, or eight positive, or lead peroxide plates to a cell. These are



If your battery were cased in glass instead of the usual hard rubber, this is what you would see. At top are the filler caps, terminals, and plate connectors. An even number of positive plates are sandwiched by an odd number of negative plates. Traps at bottom keep sulphate sediment from piling up to short-circuit the plates. Separators keep plates from touching, and dilute acid reaches nearly to top

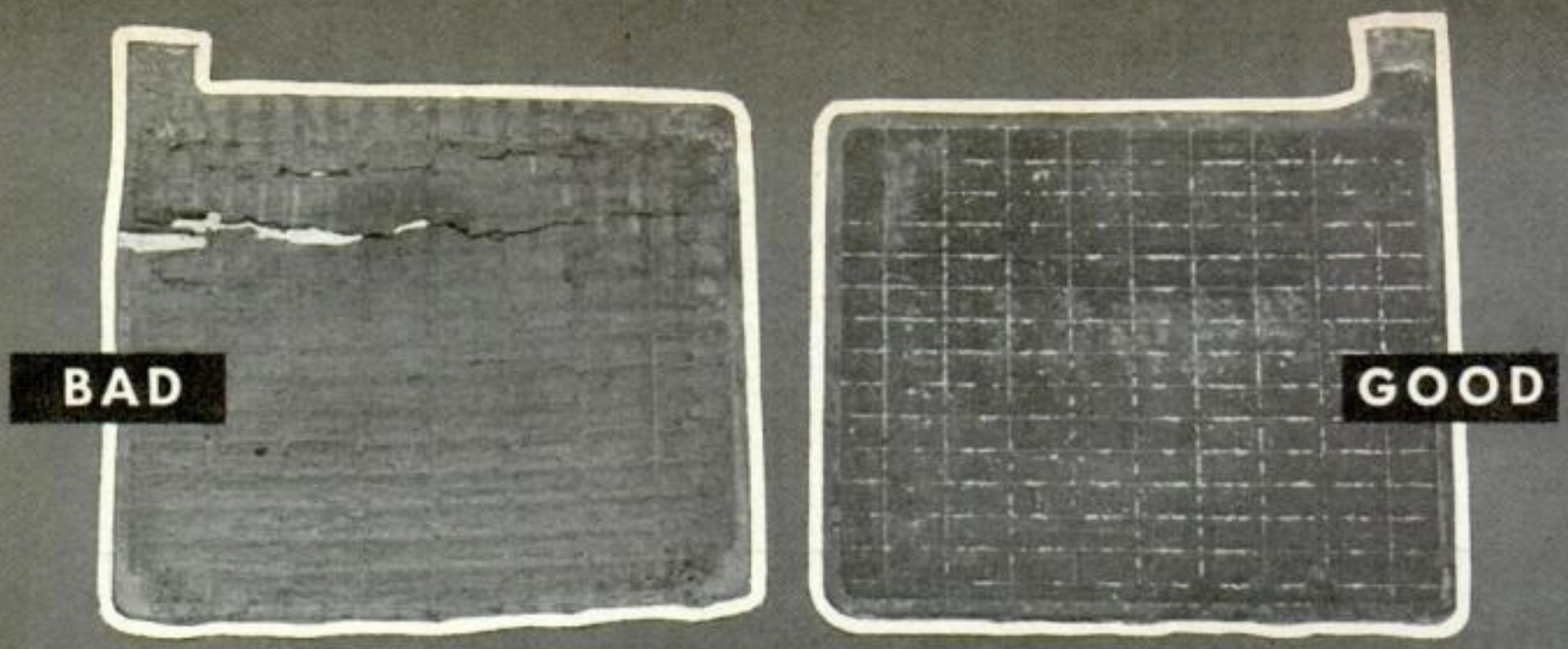
alternated between seven, eight, or nine negative, or pure lead plates. Thus three such cells will give either a 39, 45, or 51-plate battery.

In the individual cells, thin separators prevent the plates from touching each other. These usually are of chemically treated cedar, frequently supplemented by porous mats of glass fiber or hard rubber.

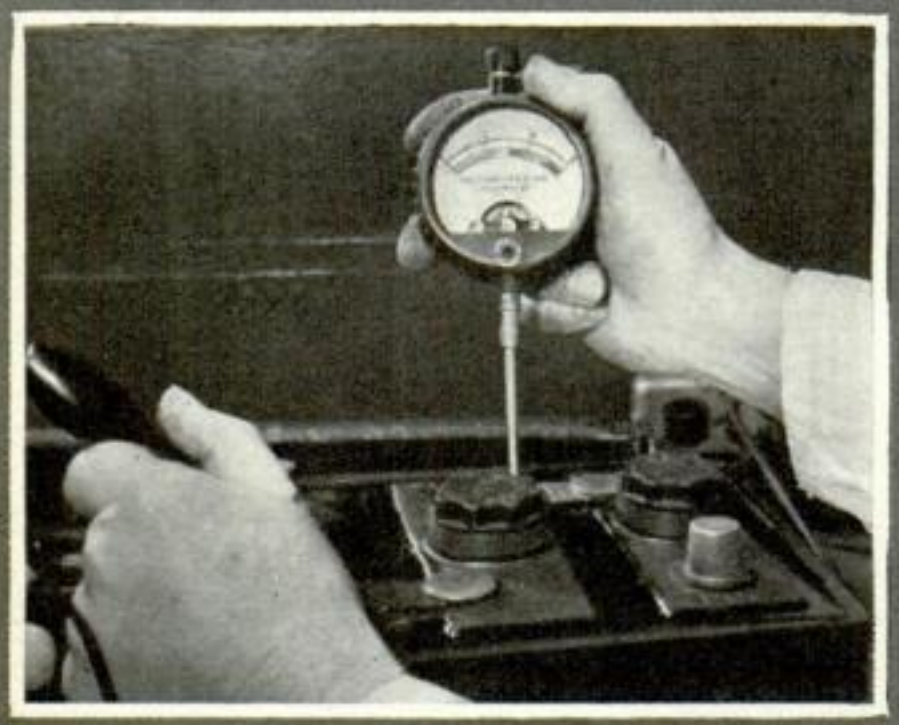
The plates are porous and reinforced with lead-alloy grids during manufacture. Because of their porosity, the acid penetrates them thoroughly. The carefully detailed drawing above shows what a battery looks like inside. Notice that all the positive plates in each cell are connected to a single terminal, and the negative plates to another. The two-volt cells are connected in series by the solid lead-alloy bars on the top of the case, so that just two main terminals are provided.

The plates and sulphuric acid react chemically when electrical resistance such as a headlight bulb is connected to these terminals. Throughout the porous plates, ions of electricity are set free to flow from the terminals as the plates change gradually into lead sulphate, and bubbles of hydrogen and oxygen escape from the vent holes in the filler caps.

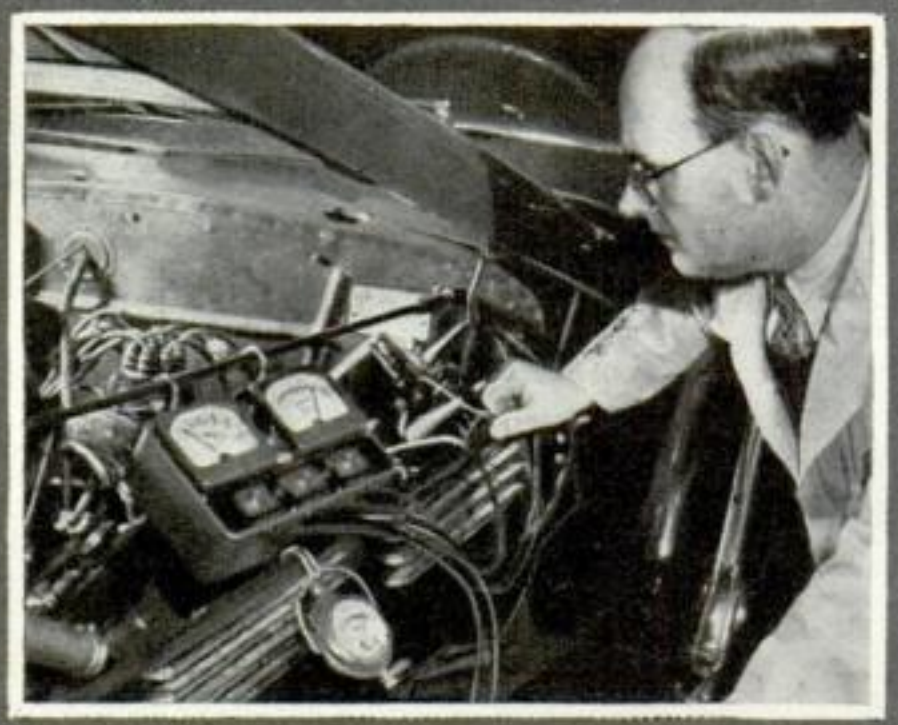
If you connect a spinning generator instead of a bulb to the terminals, the direction of the current is reversed, electric ions pour back into the battery, and most of the sulphate returns slowly to the solution to re-create sulphuric acid. Some sulphate is



So much fixed sulphate had formed in the "bad" plate, left, that it split the badly oxidized grid or framework of the plate wide open. Overcharging and insufficient water probably contributed to the destruction. At right, a good plate showing porous lead "pasted" on the grid



Testing one cell at a time with a voltmeter helps isolate your battery trouble, since a low reading on one cell indicates it is deteriorating faster than is normal



Watchdog of the charge and discharge of your car battery is the regulator, here shown mounted on the dashboard and being checked with a tester for its adjustment

CARE

Nothing works right in your battery circuit when corroded terminals set up resistance or break the circuit completely. A wire brush, used cautiously, cleans them

The familiar battery hydrometer tests the weight (specific gravity) of the acid solution. Like the voltmeter, it compares the condition and state of charge of the cells

always lost and eventually filters into traps in the bottom of the case. That is why no battery lasts forever. Also, the hydrogen and oxygen, which are constituents of water, are not returned. But at least you can replace the water.

Never add water to the overflow point. If you do, the solution will soak the battery top and terminals, perhaps the cables as well. The acid attacks the iron and copper in these fittings and in time will destroy them. The powdery stuff you sometimes see on them is the by-product sulphate of this destruction. Clean it off and wash the parts with baking soda and water. Then, make sure you don't let it happen again!

While the motorist can regulate a battery's water supply, the generator cannot regulate its supply of charging energy. An automatic regulator is therefore used on modern cars to control the current supplied to the battery. This usually has three parts.

One of them is a generator cut-out. Really a magnetic switch between the battery and generator, its contact points are held open by a spring when the generator is at rest. They are magnetically closed when the generator energizes two windings or coils, so that the generator output can flow to the battery. When the generator stops again, current tries to flow back from the battery. In doing so, it runs backwards through one of the windings. The windings then oppose and neutralize each other, releasing the contact arm and disconnecting the generator.

Another part of the regulator is the voltage control. Modern generators are powerful and would direct too large a voltage at the battery without this unit. Like the cut-out, it has two windings. As the battery approaches a full charge, the control's points open to send the current of one winding through a resistance to ground. With the opened coil circuit, the magnetic field weakens until the spring again closes the points. The process repeats, vibrating the points rapidly and never letting the voltage exceed a safe limit for the battery.

As a third unit of the regulator, there is a current control that keeps the generator from working too hard at high speeds. A single coil carrying the entire generator output opens a set of points when the output becomes too great. This switches the field output through a resistance and the output immediately drops off, closing the points again. Vibration of the points thus regulates the current peak.

You can recognize the infrequent troubles of this three-in-one regulator device by watching your dashboard ammeter. If the needle fluctuates, shows a discharge when it obviously should show charge, or shows excessive charging, the trouble may well be in the regulator. An overcharged or undercharged battery may mean an incorrect adjustment. Your problem is to find a regulator expert equipped to make the extremely critical adjustments.

No battery is better than its regulator. Nor is a battery better than the care it gets. A hydrometer to test its specific gravity is as informative as taking a person's temperature. It shows the weight of the acid compared with water. As we saw above, discharging transfers some of the sulphate from the acid to the battery plates. The remaining liquid is lighter in weight. Recharging the battery returns the sulphate to the acid solution and the liquid grows heavier again. The weight of the liquid therefore is in proportion to the state of battery charge.

Besides using a hydrometer, you should test a battery with a voltmeter, cell-by-cell and across all the cells. If one cell is weak, the entire battery is affected. A sure way to show up a bad cell is by testing a battery under a heavy load such as that of your starter motor. A heavy load causes the voltage output to fall off anyway, but, if one cell is failing, the voltage will drop excessively soon after the heavy load is imposed.

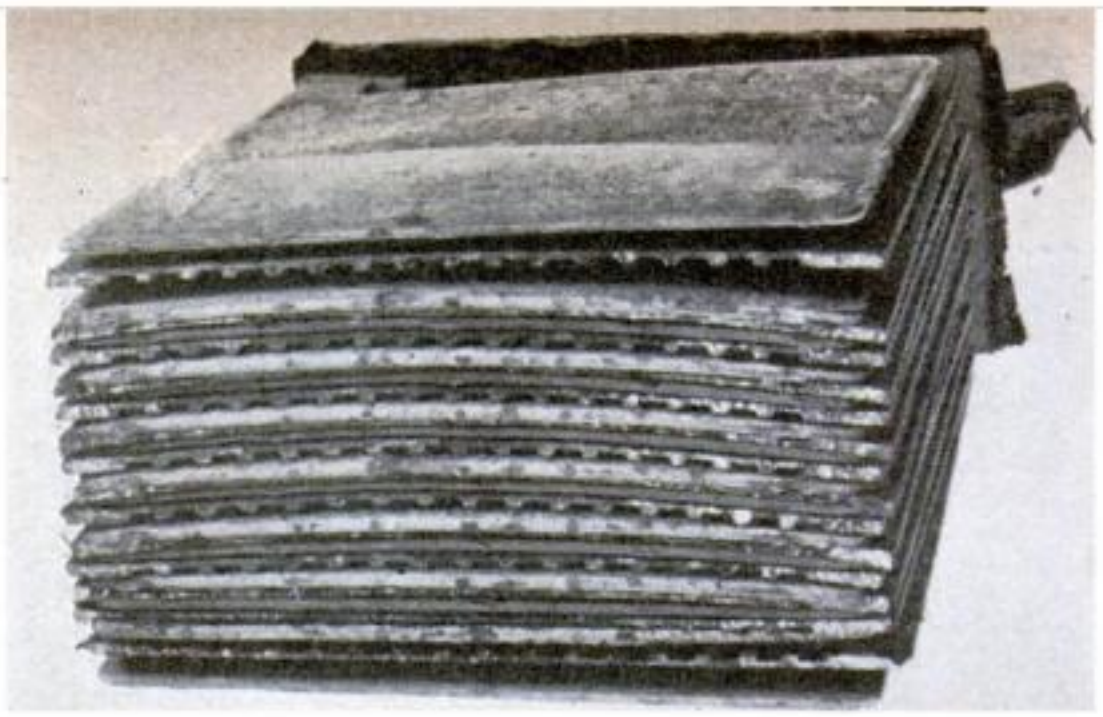
Batteries are sensitive to temperature. In hot weather, for example, voltage increases. In cold weather it is lower. The acid in a charged battery will not freeze even at extreme subzero temperatures. But in a seriously discharged battery, the acid is proportionately weak with a relatively high freezing point. It is thus doubly important to keep batteries charged in winter. You need their extra power for turning over a cold motor, and you must avoid the freezing danger. In hot weather, the normally greater chemical activity and heat speed the escape of hydrogen and oxygen, so that water must be added oftener.

Never let a battery sit loosely in its holder. Vibration will wear and weaken the case and cables. Neither should it be so firmly clamped as to warp or crush it. And bear in mind that battery tops are easily broken by too-energetic application of the clamp-tightening or the carrying tools.

When car manufacturers began building cars with floors so low that there was no longer room for batteries under the seat or the front floor, it was a break for batteries and motorists alike. Batteries came up, as

it were, from the cellar to the living room where they could be seen.

No longer is it necessary to half-dismantle your car to inspect the battery. Every time you or your service man opens the hood to add oil or water, the battery is at hand. Incidentally, on many cars, as a space-saving expedient, the cells of batteries are arranged end to end in their containers when the batteries are thus placed beneath the hood. There is no difference between this style battery and the old-type squarish ones in which the identical cells were side by side.

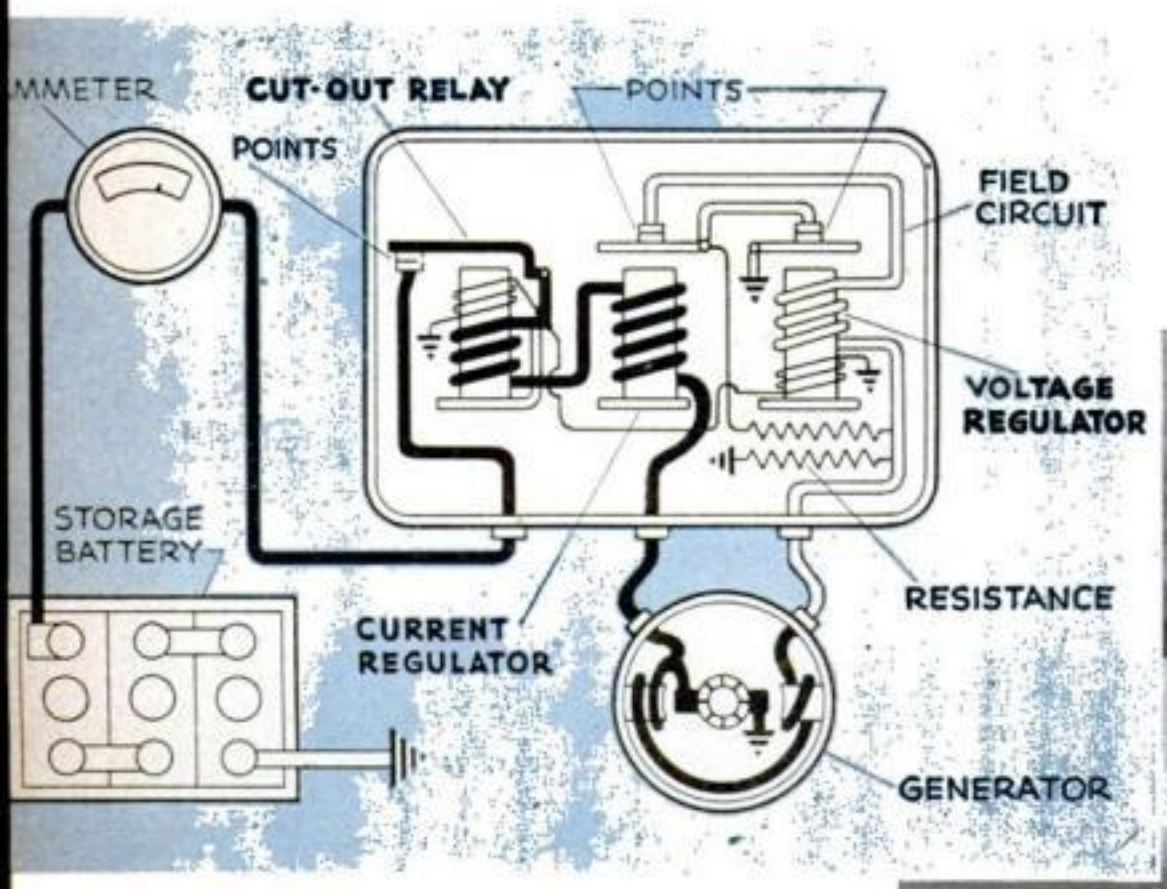


Discharged until sulphate deposits buckled the metal plates, this overworked, underwatered, neglected cell unit is just junk. Proper care would have prevented this from happening

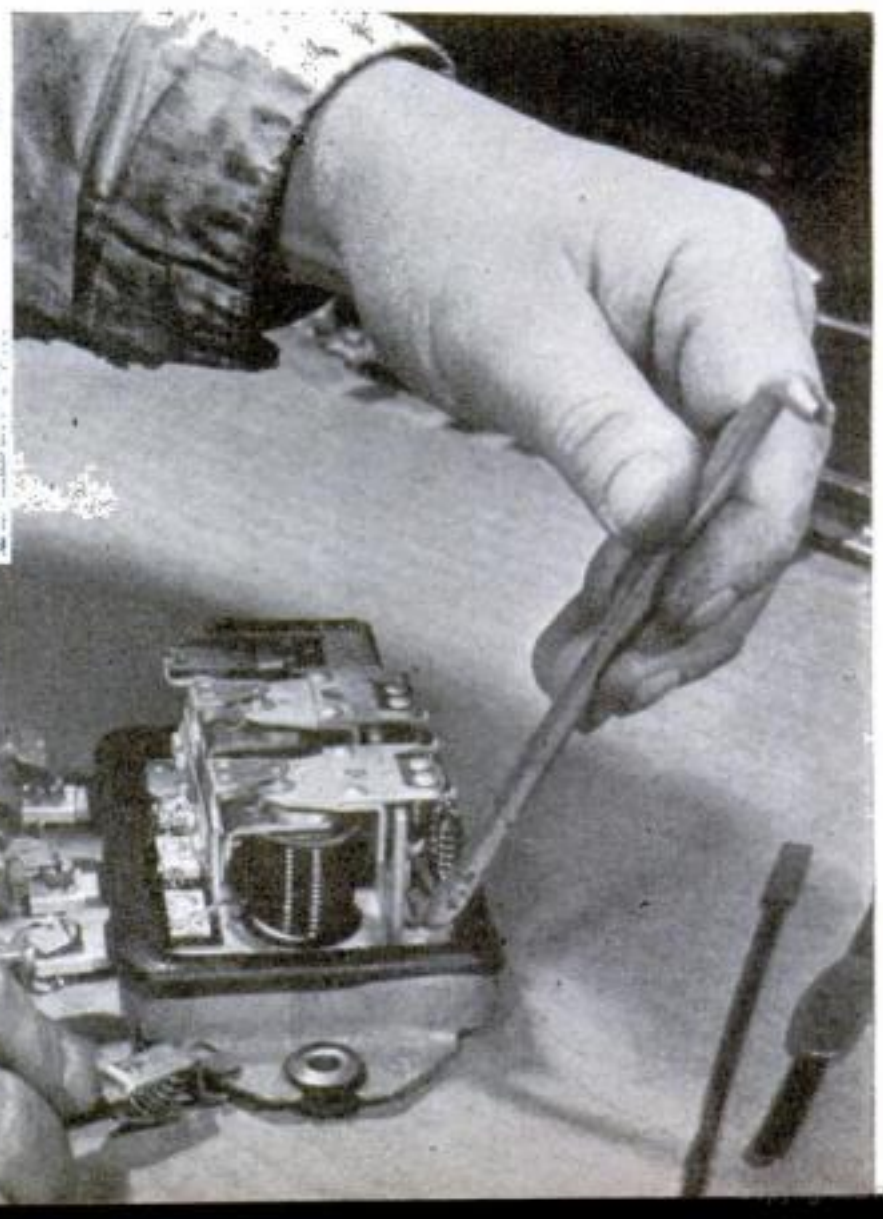
There is a particularly important item to watch if your battery is to perform all its functions properly. This is the condition of the cables. As noted, cable clamps at the terminals must be kept clean of corrosion. Just as important is it to keep them tight. And always bear in mind that they can become loose at either end. If the ground strap, for instance, should work loose where it attaches to the chassis, or to the motor block as on some cars, the same sort of "resistance" is introduced that you would get from a corroded or half-broken cable.

One of the first signs of this trouble may be abnormal brightening of the headlights as your motor speeds up. For the battery itself is a regulator of the voltage of the car's entire electric system. If a loose battery connection occurs, it eliminates the battery partly or completely from the electric system. The full voltage of the generator may then go through the system. It will promptly burn out lamps if not corrected. In addition, it will burn distributor points and damage other parts of the ignition system.

If you expect your battery to last, it must have care. To sum up your responsibility in accomplishing this, you must keep it clean, filled, and as fully charged as possible. Let your service man inspect and adjust the complicated regulator periodically, as well as the generator and wiring. These are the commandments of battery care. It will pay you not to break them.



The brains of a car battery circuit are the three control units inside the central area of this drawing. Of these units, one is a cut-out that disconnects the generator when it idles or stops. Another, the voltage regulator, prevents too much voltage from reaching the battery. Third, the current regulator, protects the generator. Adjustments, right, are for experts only!



Care of Inner Tubes

WITH proper care, an inner tube will last as long as a tire casing of comparable quality. But it must fit, it must be carefully installed, and, after installation, should be pumped up, completely deflated, then pumped up a second time to recommended pressure. After that, it is largely a matter of maintaining the pressure with a weekly check-up; more often if you drive much.

DO'S

USE NEW TUBES, if you can get them, in new or even in secondhand casings. Tubes gradually become thin and porous in use; thus may leak rapidly and shorten the life of a casing.

REMOVE DIRT, pebbles, and possible bits of torn tire wrapping from casing before inserting a tube. Tube also should be clean. Any foreign objects next to it will wear away the rubber.

USE A GOOD GAUGE to test tire pressure. An inaccuracy of three pounds either way can cut thousands of miles from the life of your tires. Underinflation overheats tubes seriously.

BE SURE beads are in place on rim before inflating tube. Always beware of pinching tubes. On Chrysler "safety rims," listen for two popping sounds as beads seat during inflation.

REBALANCE WHEELS after tubes have been switched in the casings or new ones installed. Simply switching wheels does not unbalance assemblies that were in good balance to start with.

USE CARE with tire irons to avoid damaging tubes. Even a light pinch, which does not cause a leak at the time, may develop into a slow leak later. Keep irons clear of the valves.

CENTER TUBE carefully before mounting casing on a rim. If it is twisted or folded anywhere, straighten and smooth it by running your hand around inside the casing until it is free.

SOAP CASING BEADS to simplify mounting and reduce danger of injuring tubes. Use only a good-quality, pure, vegetable-oil hand soap, and in no case apply oil or grease to beads.

DON'TS

NEVER INSTALL tubes that are either oversize or undersize. Despite elasticity, they do not accommodate themselves properly, and ruinous folding or stretching results.

DON'T PUT BACK old valve cores that have seen a lot of service, and don't put them in new tubes. Good valves, which are inexpensive, are the vital guardians of pressure in tubes.

DON'T PUT WET TUBES into casings. While it is harmless to test tubes under water for leaks, they should always be wiped dry to avoid trapping any water in the inflated casings.

DON'T USE TOO MUCH talc or soapstone between tubes and casings. It might cake in one place, causing a wear spot. If a very little is applied and spread evenly, it works better.

DON'T ADD AIR unless you have made sure that the valve is clean. Dirt forced into the valve mechanism will cause leaks. Clean by releasing a little air or blowing with compressed air.

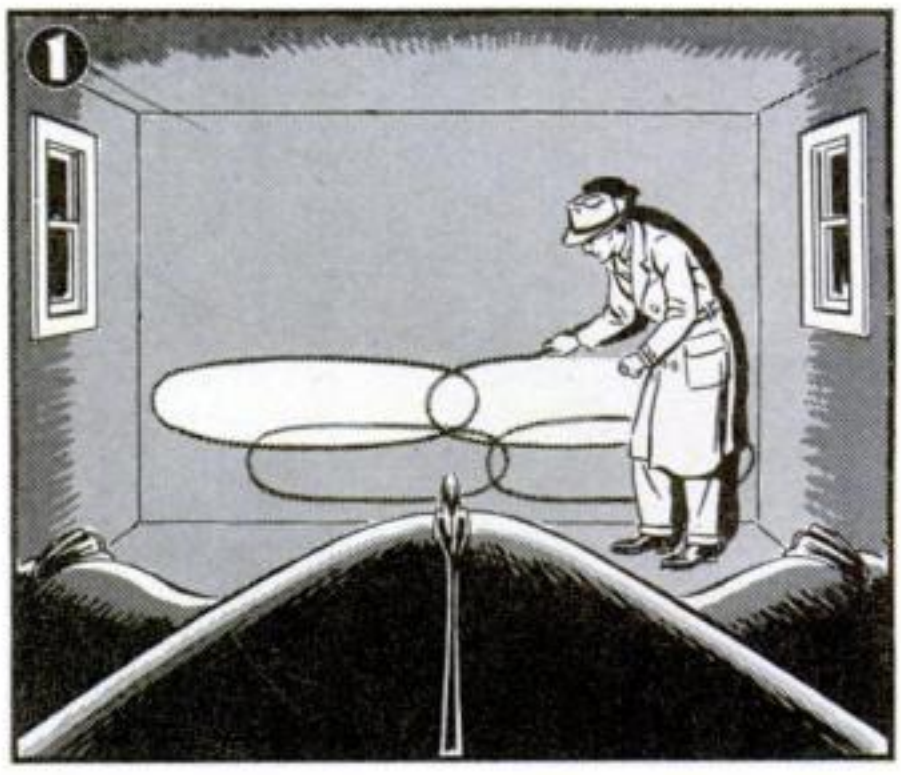
NEVER BALLOON a tube, as shown, when testing it for leaks. Thus stretched, inner-tube rubber may be permanently weakened and weakened spots rapidly become porous during operation.

DON'T DAMAGE the soft rubber lip around the inner edge of the tire bead with tire iron. It forms a smooth edge for the tube between casing and rim. If broken, tube injury may result.

NEVER PUT TUBES or casings down on a greasy floor or workbench. Oil and grease rot rubber. Remove any oil with gasoline, wash with soap and water, rinse, and dry before installing.

EIGHT THINGS TO DO

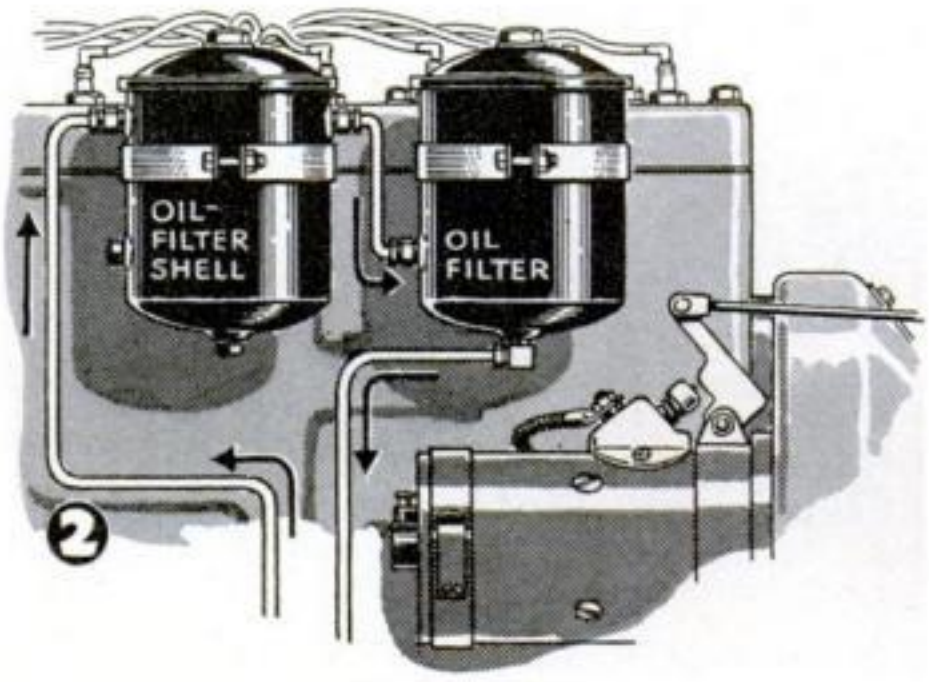
1 HEADLIGHT-BEAM GUIDE LINES drawn on the wall of your garage with the car centered and backed away a few feet will facilitate adjustments and permit frequent check-ups on the angles of the traffic and country beams. Additional marks painted on the floor beside one front and one rear wheel will help you place the car exactly where it was when the light-guide lines were made.—D.F.



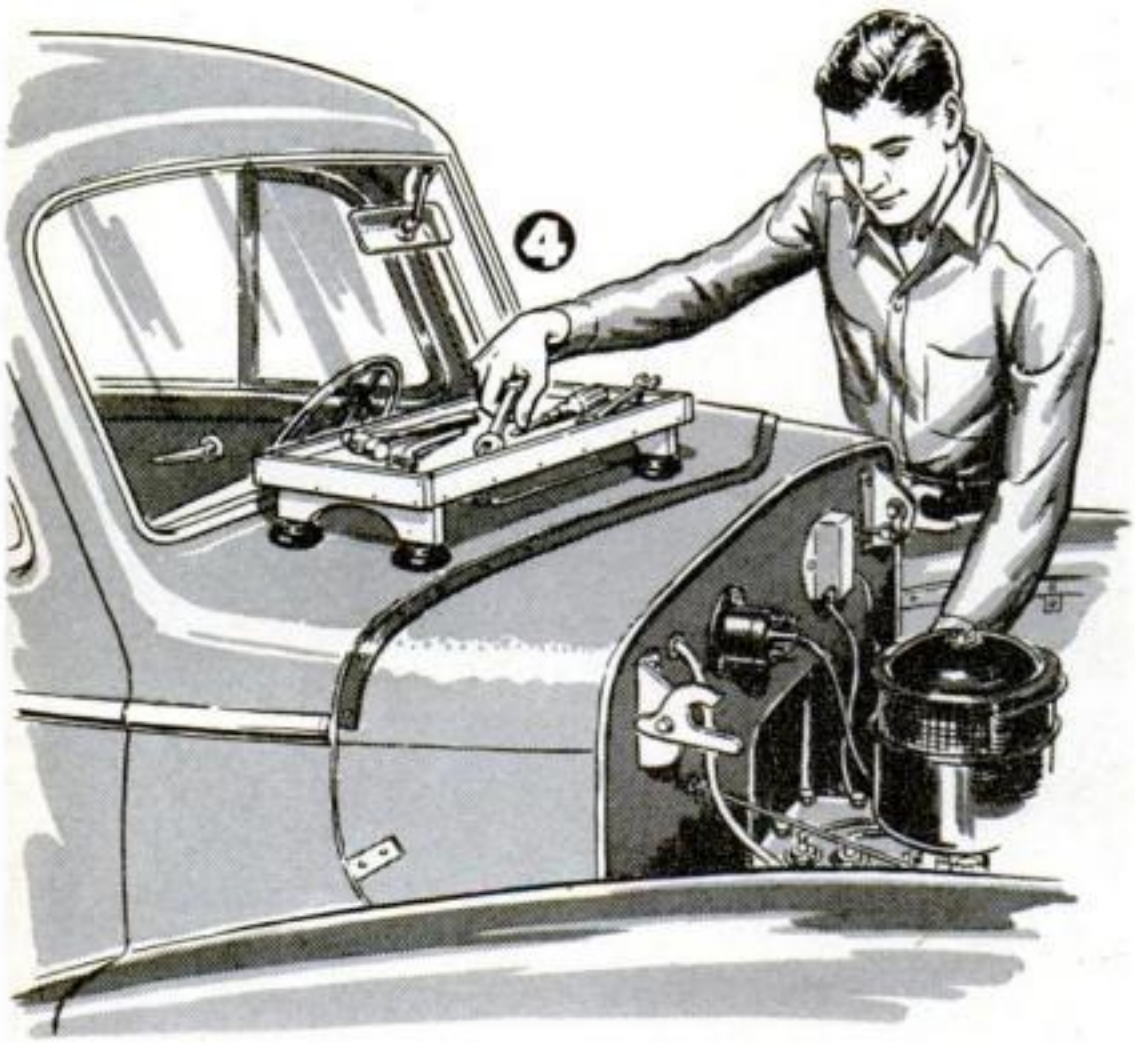
2 AN OIL-FILTER SHELL of the replaceable-cartridge type, connected as shown into the intake line of your existing filter, makes an effective sediment trap. Remove the cartridge from the filter shell to be added and mount the shell securely on the motor block. Use care in loosening couplings as they are easily damaged.—M.H.

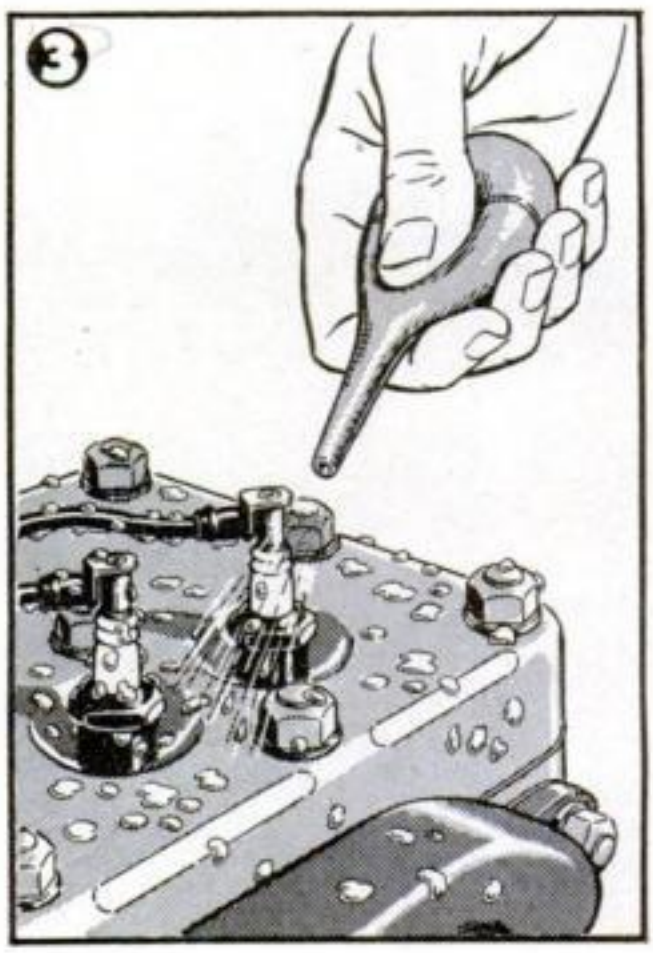
3 DRYING SPARK PLUGS after a car has been left in the rain is sometimes a difficult chore. A rubber ear syringe of the type illustrated reaches to the bottom of each spark-plug recess to suck up most of the water, after which a few puffs from the tip will remove remaining moisture.—F.K.

4 A TOOL TRAY to keep tools handy while you are working on a car motor can be made from a plywood or other thin board, with four vacuum cups attached to short legs at the corners and low sides to keep articles from rolling off. The rubber feet will not mar a car's finish, while the vacuum cups prevent the tray from slipping.—L.K.

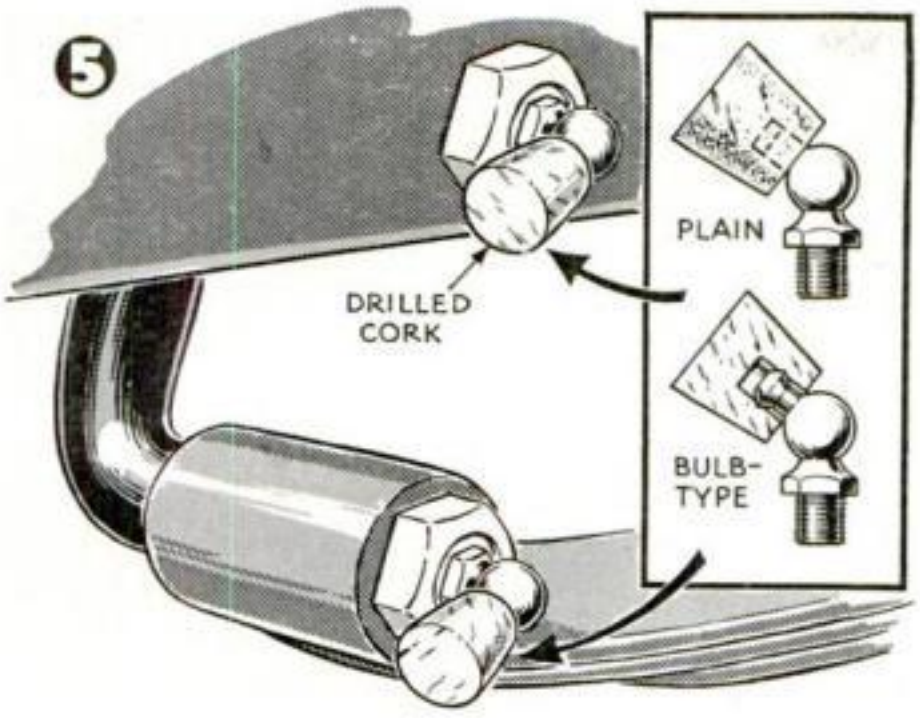


Drawings by
STEWART ROUSE

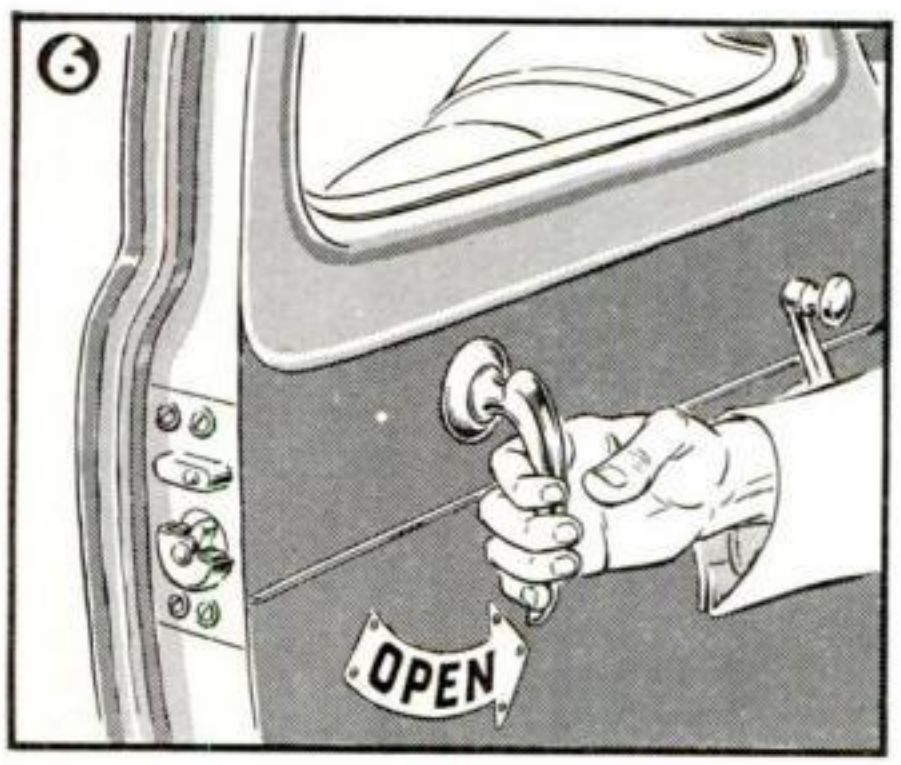




TO IMPROVE YOUR CAR



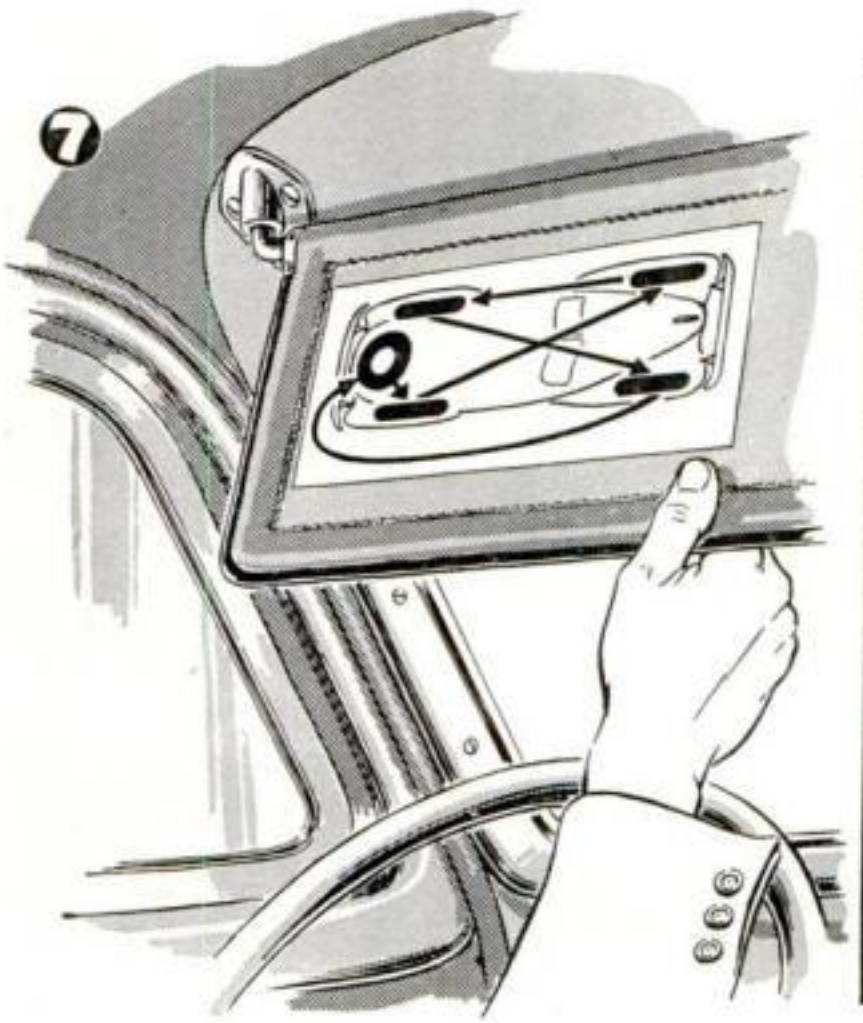
5 **DUST CAPS** that will keep the open ends of chassis grease fittings clean can be made with medicine-bottle corks. Drill holes, slightly undersize, partly through the corks and force the corks over the fitting nipples. When removed, they leave the fittings clean instead of covered with a layer of greasy dirt which would be forced into the bearings by a grease gun.—A.G.C.

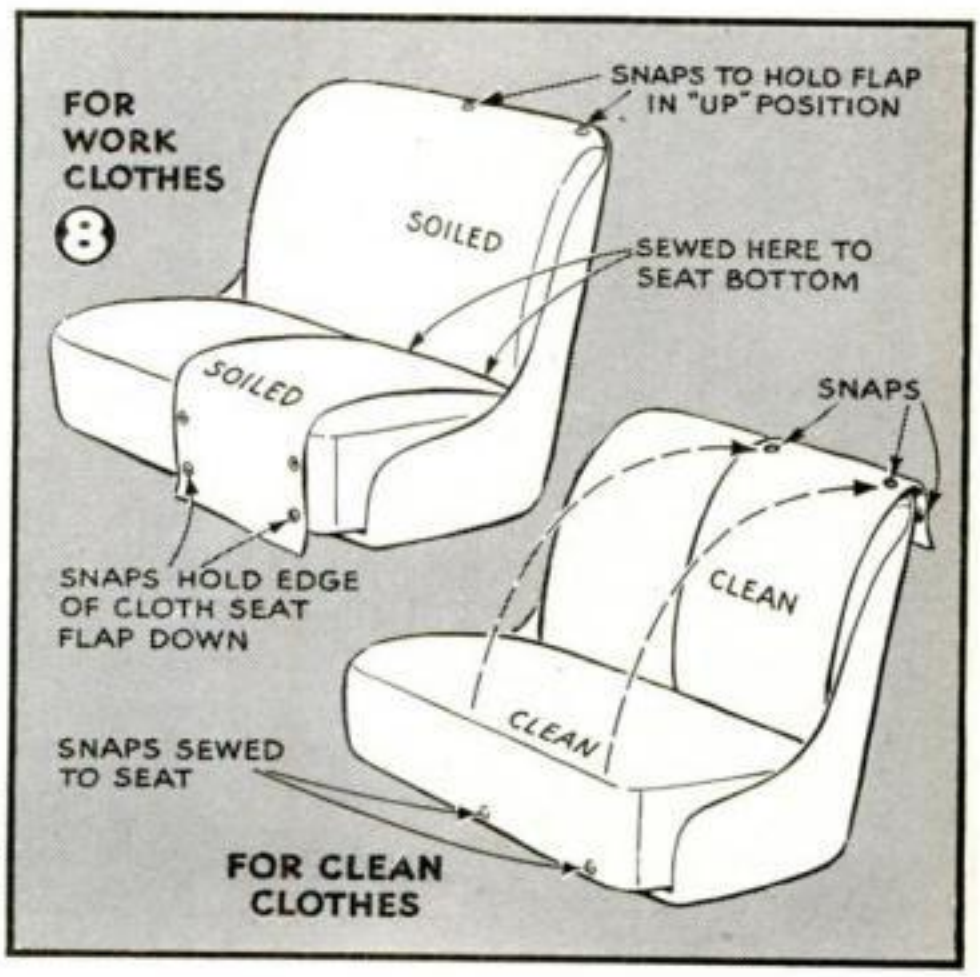


6 **ARROWS MARKED 'OPEN'**, properly placed beneath the inside door handles of a sedan, will quickly indicate to puzzled passengers the answer to their usual dilemma as to which way to turn the handles to open the car doors. If cut from sheet metal for durability, the markers' edges should be carefuly rounded with a file. Good glue or self-threading screws hold them in place.—T.F.

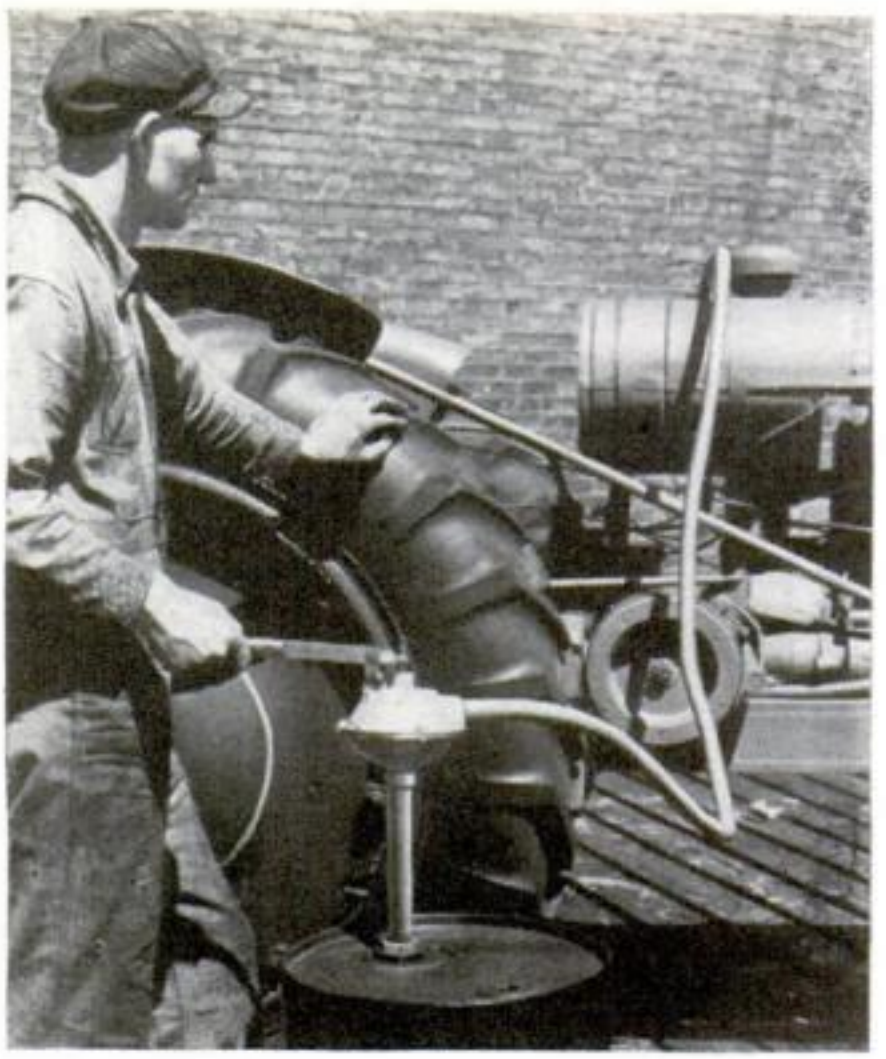
7 **A TIRE-CHANGE REMINDER**, to tell you when to shift tires around for equal wear, can be fastened to a sun visor. Cover a small diagram (see P. S. M., Feb. '42, p. 133) with transparent celluloid. Sand a strip at the bottom for writing in the mileage, and cement the unit to the visor.—T.T.

8 **AN UPHOLSTERY-MATCHING FLAP**, sewed as shown to the driver's seat, keeps the seat clean. When driving in work clothes, the driver sits on the flap. At other times, the flap is fastened up against the seat back with properly placed snap buttons, thus hiding any marks left on the material.—R.A.

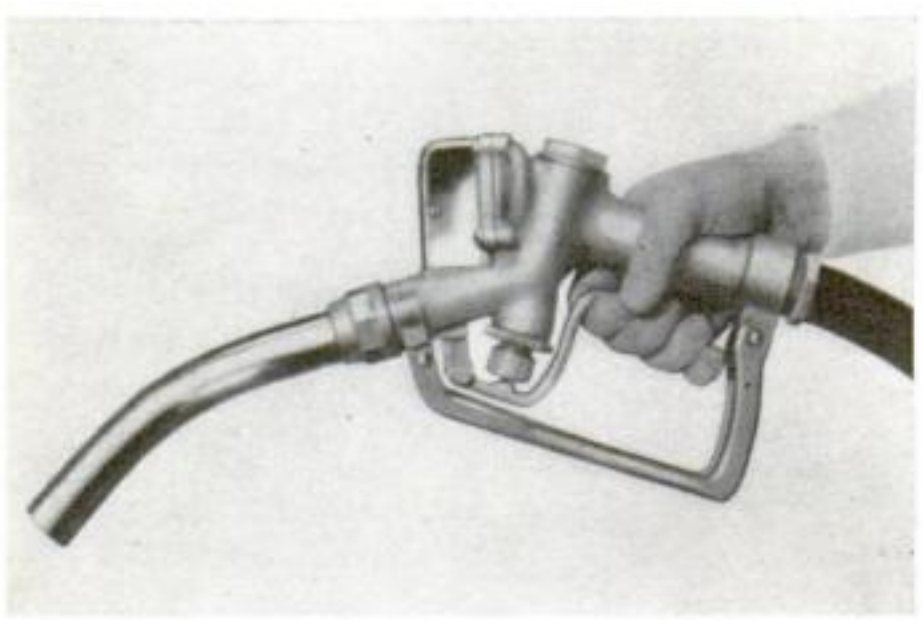




Auto Ideas



A DISPENSING PUMP that handles gasoline, alcohol, water, kerosene, or any common liquid without danger of seizing or sticking has been devised for farms, machine shops, stores, and other places where a variety of fluids are handled. Using a diaphragm-type pumping unit instead of a piston, the dispenser is intended to draw liquid directly from drums or underground storage tanks, passing it through a flexible hose to the desired container. Hand operated, it has a capacity of 15 gallons a minute. Self-lubricating packing around the plunger makes it independent of attention.



SHUTTING ITSELF OFF when a car gasoline tank is full, an automatic filling-station hose nozzle prevents tanks from overflowing and spilling gasoline over fenders to spot the finish and waste fuel and money. Inserted in the filler neck of a gas tank, the nozzle is opened by a hand valve as with ordinary nozzles. When the gas tank is full, gasoline starts to rise in the filler neck. As soon as it reaches the level of the tip of the filler spout, an automatic valve shuts off the flow. The device speeds up filling-station service.

SPILLPROOFING is accomplished at the gasoline tank itself with a specially constructed filler neck that whistles a warning note while gas is entering the tank. Just before the tank becomes full, the whistling stops, and the gas-station attendant knows it is time to shut the nozzle valve. At the right is illustrated the common casualty of overfilling a tank and a representation of the whistling alarm that requires only the filler's attention to prevent such an accident. It is especially handy at night.

GUS solves a mystery

Gus was wakened by the telephone on the table near his bed. He switched on a light sleepily and looked at his watch. Five minutes to three

With a truck and its driver both apparently allergic to graveyards, the Model Garage boss has spooks plus motor trouble to lick—at 3 a. m.

By MARTIN BUNN

ONE evening when Gus Wilson was working overtime in his Model Garage shop the door was pushed open and a man he didn't know came in. He was a middle-aged, competent-looking citizen obviously plenty worried about something. He gave Gus a quick look and said: "You're Mr. Wilson, I take it."

Gus grinned and said that he was guilty.

"My name's Horner," the visitor told him. "I'm the new general superintendent over at the Johnson and Fredericks plant. We're losing sleep over a truck mystery, and Mr. Fredericks suggested that I see you."

"Glad to know you, Mr. Horner," Gus said heartily. "Sit down. We used to do Johnson and Fredericks' work, until they grew so big they had to have their own maintenance shop. How many trucks are you running now?"

"Seven. Six new ones, and an old one. It's the old one we're having the trouble with. Perhaps you remember it," said Horner, describing it.

Gus nodded. He never forgets a vehicle he has worked on.

"I suppose you know," Horner went on, "how we are operating our plant since we converted it to 100-percent war production —that we are making parts for some larger manufacturers, and that we also are subcontracting some of our work to several smaller plants up-state. We make some of our deliveries and pick-ups by truck. On one of the most important of them we're using that old truck. The driver is a colored man named Peter. He's hard-working and dependable, but he's no mechanic.

"Peter leaves our plant about nine o'clock every evening with parts we've finished that day for a big plant up in Millboro. He makes quite a few pick-ups and deliveries, covering about 140 miles. He gets back to the plant about two o'clock. In the morning his truck is serviced, and it isn't driven until he starts out again that evening.

"That brings us to the mystery. When Peter came in one night about a week ago I happened to be in the plant and he complained to me that he'd had trouble coming in from his last stop, which is at Springdale; that his motor had missed badly all 40 miles of the way, and on several occasions had almost died. I left a note for John Dill, the man who has charge of our trucks. Next day Dill checked the ignition, which he says he found O. K., and cleaned out the carburetor. Then he road-tested the truck and found that it ran perfectly. But that night Peter came in from his trip almost an hour late and said that exactly the same thing had happened again—that the truck had sputtered all the way from Springdale home."

"Springdale," Gus repeated reflectively. "Yes, I remember it—it's a little place a mile or so back from the highway. There's an old church there with a big graveyard full of old tombstones."

Horner laughed. "That graveyard is what's bothering Peter worse than anything

else," he said. "He says that his motor always starts missing just about the time he comes in sight of the church on his way back to the highway from Springdale after he has made his pick-up, and he swears that if it ever goes dead on him while he's passing the graveyard he's going to quit his job right then and there! Well, Mr. Wilson, any bright ideas?"

"Not a one," Gus told him cheerfully. "I've got to see the truck, first. What else has Dill done to try to scotch the grief?"

"Dill spent a whole afternoon working on the carburetor and fuel pump. He checked the fuel line all the way from the gas tank to the carburetor. He checked the distributor and replaced a few parts. When he got through, that old truck ran like a new one. But that night Peter had the same trouble."

Gus scratched his left ear with the forefinger of his right hand—a sure sign that he is thoroughly puzzled. "If that dirt road was a rough one, it might jar something loose," he said. "But I drove over it only a couple of weeks ago and I remember that it wasn't rough. Let's see now—a plugged filler cap wouldn't let the engine run for a hundred miles before it began to get in its dirty work. . . It might be vapor lock. . ."

"Dill thought of vapor lock yesterday," Horner interrupted. "He insulated the gas line from the fuel pump to the carburetor. But last night the truck acted the same way only worse—Peter had a real job getting it home at all."

Horner scowled, and went on: "You can guess, Mr. Wilson, that in my job I've got plenty of things besides balky trucks to worry about. This morning I even called up the dealer from whom the truck had been bought. The dealer sent a service man around, and after he had checked everything thoroughly he said that he was stumped, too. If Peter has any more trouble with it, as I have a strong hunch he is going to, I wish that you would take it tomorrow morning and find out what's the matter."

"Sure, send the truck around," Gus told him. "I won't promise that I'll be able to solve your mystery, but I'll do my darnedest."

Before daybreak on the following morning, Gus was awakened by the jingling of the telephone on the table near his bed. He switched on a light and looked at his watch. Five minutes to three. He picked up the receiver sleepily and said, "Hello."

"Horner speaking," a voice at the other end of the wire said crisply. "Sorry to wake you up, but we're in a jam. It's that truck again! A few minutes ago our subcontractor's factory up in Springdale called me and said that one of their men, on his way to work on a late shift, had seen our truck standing in the middle of the dirt road in front of that church with its lights on but no one in it. Apparently the motor has gone dead for good this time and Peter has gone off somewhere in disgust. Whatever has happened to him we've *got* to have those parts first thing in the morning—and we can't leave the truck standing there in the road. Can you send a wrecker after it?"

"I'll have to go myself," Gus said. "I won't need the wrecker, but you'll have to send someone with me to drive the truck back here in case I can't locate Peter . . . What? . . . Oh, yes, I know what *must* be the matter with your truck—it came to me after I got into bed, the way ideas sometimes do!"

"I hope you're right," Horner said testily. "I'll go with you myself. Stop at my house on your way out of town, will you?"

Gus dressed fireman fashion, got into his old roadster, and drove around to the Model Garage. There he stopped just long enough to get a five-gallon can of gasoline and put it in the back of his car. Then he drove over to Horner's house and found the superintendent waiting at the curb.

"Well, what's your idea of what's the matter with that confounded truck?" Horner demanded as soon as he got in.

"Wait until we get out to it," he said. "I *must* be right—but then I might be wrong!"

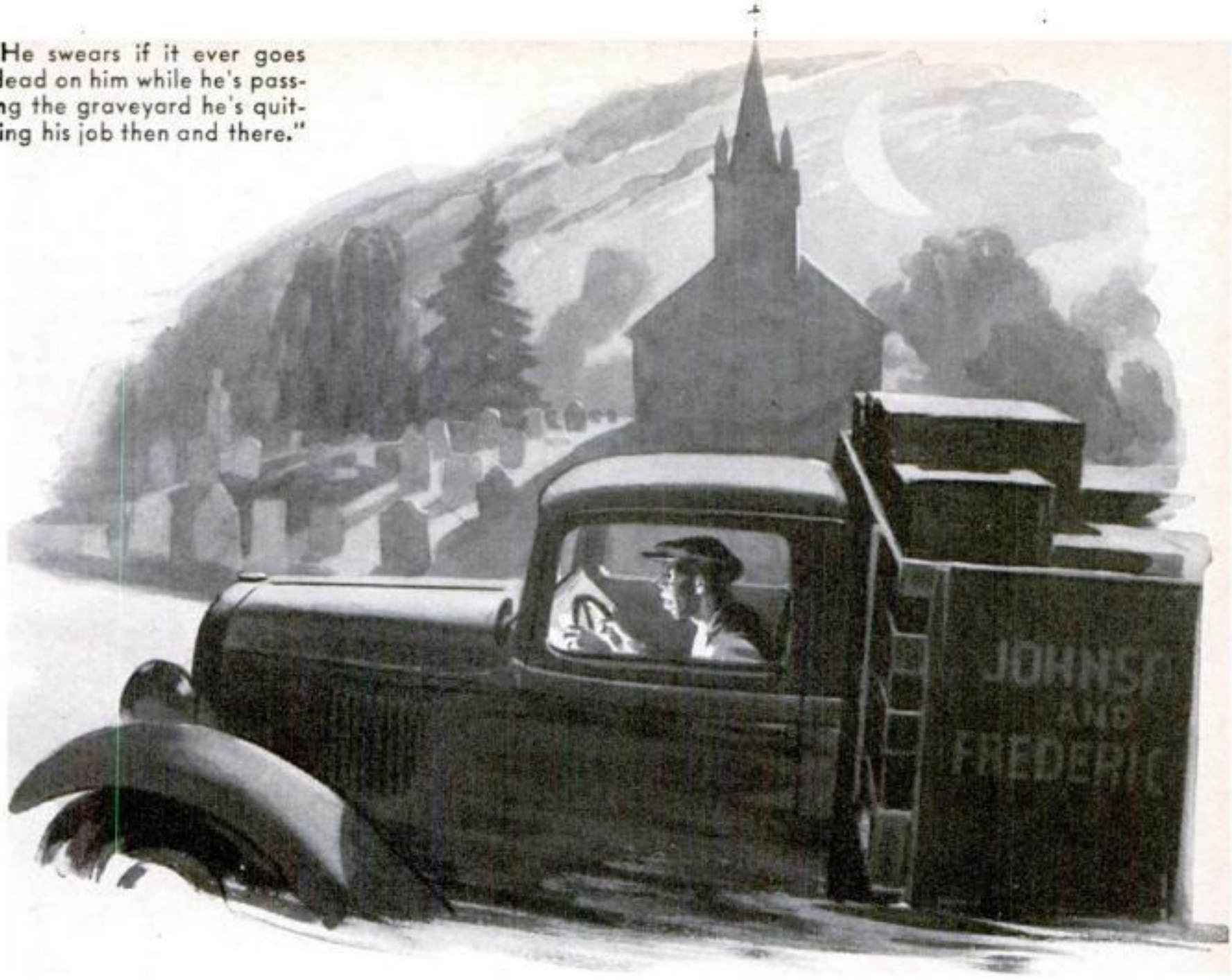
"Cold comfort!" Horner growled, and lapsed into a grouchy silence. A little under an hour after they started Gus turned off the concrete onto a good dirt road. A half disk of dying moon was shining sickly above the rising mist, and in its light they saw the steeple of the old church. Then, after a minute or so, they saw twin red lights in the road ahead of them.

Gus drove up beside the stalled truck and stopped. Its headlights were full on. The mist drifted eerily in their glare. Horner shouted: "Peter! Peter! Where are you, Peter?"

His voice died away, and there was no sound but the purr of the road-

GUS SAYS:

People keep asking how to keep thieves from stealing their tires. If you put locks on wheel lugs, thieves swipe the whole wheel. If you put a lock on an axle nut, a drop-center tire still comes off easily. The best bet is to lock your car inside a secure garage!



"He swears if it ever goes dead on him while he's passing the graveyard he's quitting his job then and there."

ster's engine. Over in the old graveyard the mist wasn't so heavy, and it rose slowly in crazy spirals in the sick moonlight that shone down on the fish-belly white of the old tombstones.

Then somewhere inside the truck there was a low moan, and a voice said: "Oh, Lawd! Oh, dear Lawd—" and was swallowed up by the silence.

Gus felt something prickle up his spine and turn his back hair into hackles. He saw Horner's mouth gape open. Then the voice in the truck said again: "Oh, Lawd! Oh, dear Lawd!"

One jump took Gus over the roadster's unopened door into the road; another jump took him to the truck. Its seat was empty. He switched on his flashlight, and in the back saw several boxes, and something long under a strip of burlap. There was another moan. Gus pulled the burlap away. A colored man was lying there, his face sooty gray and his hands clasped tight over his eyes.

Gus put his hand on his shoulder, and felt it quiver. "What's the matter?" he asked gently. "Are you hurt?"

The colored man sat up slowly at the sound of his voice, took his hands away from his eyes, and looked at him. "No, sir," he said, "I don't guess I'se hurt, but I'se sure pow'ful skeered." He looked sideways toward the graveyard, and covered his eyes again. "This—here truck's hoodooed, and them spooks over there is after me. A while back they was over here a-hootin' an' a-hollerin' at me. Oh, Lawd! Oh, dear Lawd!"

Horner had got his voice back. "Stop that nonsense!" he barked. "There's nothing to be afraid of! You ought to be ashamed of yourself! When your motor stalled why didn't you walk back to Springdale and call up the plant?"

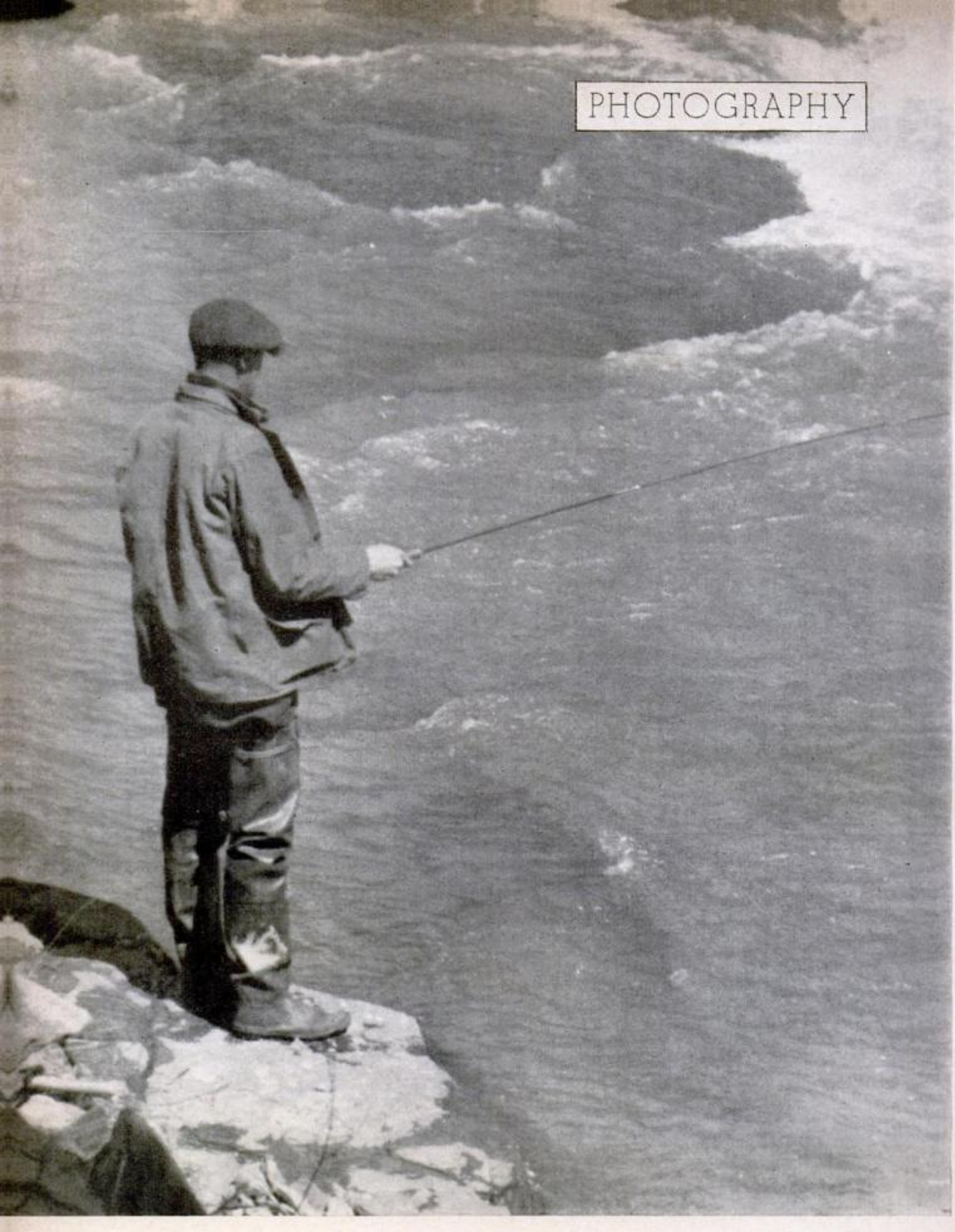
Peter Jackson shivered again. "Boss," he said simply, "I was skeered to stay here, but I was more skeered to leave!"

Gus patted his shoulder and laughed kindly. "You're all right now," he assured him. He went over to his roadster, got his can of gasoline, and emptied it into the truck's gas tank. Then he stepped on the starter—and the engine took off smoothly.

Horner stared at him. "Now, what—" he began.

"Wait until tomorrow, and I'll tell you all about it," Gus said. "You'll have to drive the truck home—Peter hasn't recovered yet. I'll take him with me."

About ten o'clock the next morning Gus was whistling *(Continued on page 210)*



Quiet alertness and swift motion are expressed by the fisherman and the rapid stream. Compare the composition of this version with that of the original uncropped photograph on page 140

Preparing Prints for Mounting

By KONRAD CRAMER
Director, Woodstock School of Photography

MANY amateur photographers seem to think that once the print image has appeared in the developer, fixing and washing remain as mere formalities, to be rushed through as quickly as possible. They content themselves with stained or impermanent prints, "oyster-shelled" surfaces, and imperfect compositions instead of taking the pains to wash, dry, and crop their photographs properly—only to hasten forth to take more pictures, which in turn are sure to suffer the same fate.

If you have in your hands a satisfactory print fresh from the developer, the next step is to turn it over several times in an acid stop bath, which halts all development, prevents staining, and will make your fixing solution last longer. Mix the stop bath as follows:

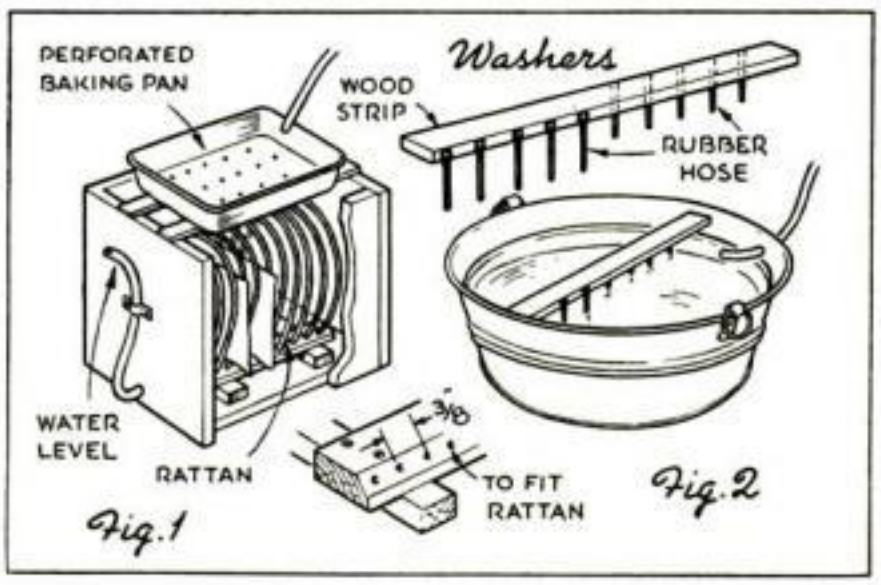
Water	32 oz.	1 liter
Acetic acid 28%	1½ oz.	48 c.c.

The following formula added to plain hypo acts as a hardener:

Water at 125 deg. F.	14 oz.	425 c.c.
Sodium sulphite, desiccated	2 oz.	60 grams
Acetic acid 28%	6 fl. oz.	190 c.c.
Potassium alum	2 oz.	60 grams
Cold water to make	32 oz.	1 liter

Dissolve the sodium sulphite thoroughly before adding the acetic acid. After the solution has been mixed well, add the potassium alum, stirring constantly. Use one part of cool solution to four parts of a 25% cool hypo solution (2 lb. of hypo to the gallon of water). The hypo must be thoroughly dissolved before the hardener is added.

Fixing. Move a print at a time into the fixing solution. Be sure to have a large enough tray with enough hypo in it. Better still, use two trays. Place your first print in one tray, and when the second print is ready slip the first one into the second tray. Do not let prints adhere to one another, but agitate them to facilitate complete fixation. Hypo is cheap. Don't use stale solution; discard it before it looks milky or feels oily between the fingers. A fresh solution will fix a print in from 10 to 20 minutes. Overlong fixing will bleach a print, as you can



WASHING. In the simple, efficient tank below and in Fig. 1, a rack holds prints upright, a perforated bread pan lets water run on and between them, and a tube draws off the hypo-laden liquid at the bottom. Rubber fingers nailed to a board (Fig. 2) keep prints from bunching in a whirlpool washer

DRYING. Lintless net curtains or cheesecloth stretched on a "book" or rack, as above, at right, or in Fig. 3, will make an ideal drier. Blotter racks (Figs. 4 and 5) are also good. The drier in Fig. 6 may be used with an electric heater such as the reflector in the photo above the drawings on the facing page

see by cutting one in half, washing one half, letting the other remain in the hypo.

Washing. When fixing is complete, we must remove all the hypo that remains on and—most important—*inside* the print. Remember that the paper backing is like a sponge, and it takes thorough washing to free it completely of all traces of hypo. Be on the safe side and wash more than necessary, but above all wash efficiently!

No matter how thoroughly you may soak a mass of packed prints, you will never remove the hypo trapped between their surfaces. An efficient washer for small batches of prints is the one we use in the Woodstock School of Photography (Fig. 1). In this washer, the prints stand on edge and the hypo-laden water is drawn off from the bottom. The washing tank and its rack should both be given a coat of photographic black paint. Rattan or reed for the rack may be obtained from stores selling kindergarten or school supplies. A thorough job of print washing can be done in about ten minutes in this washer; in other small washers prints should be left at least 30 minutes. The family bathtub or a clean kitchen sink will serve in a pinch if plenty of water is used and if the prints are prevented from stacking. Syphon washers are good, but prints must be separated by hand continuously. Round tub washers are satisfactory if prints are kept from bunching in the center of the whirlpool. No matter how

gayly a number of prints may dance around in one of these washers, they do not rid themselves of hypo. A strip of wood with a number of rubber fingers cut from rubber tubing tacked to it, as shown in Fig. 2, will hold the prints back so that the water swirls through them. Whatever method you use, make sure that all hypo has been removed from your prints. If in doubt, try a test solution. Well-washed prints will last as long as the paper stock they are made on.

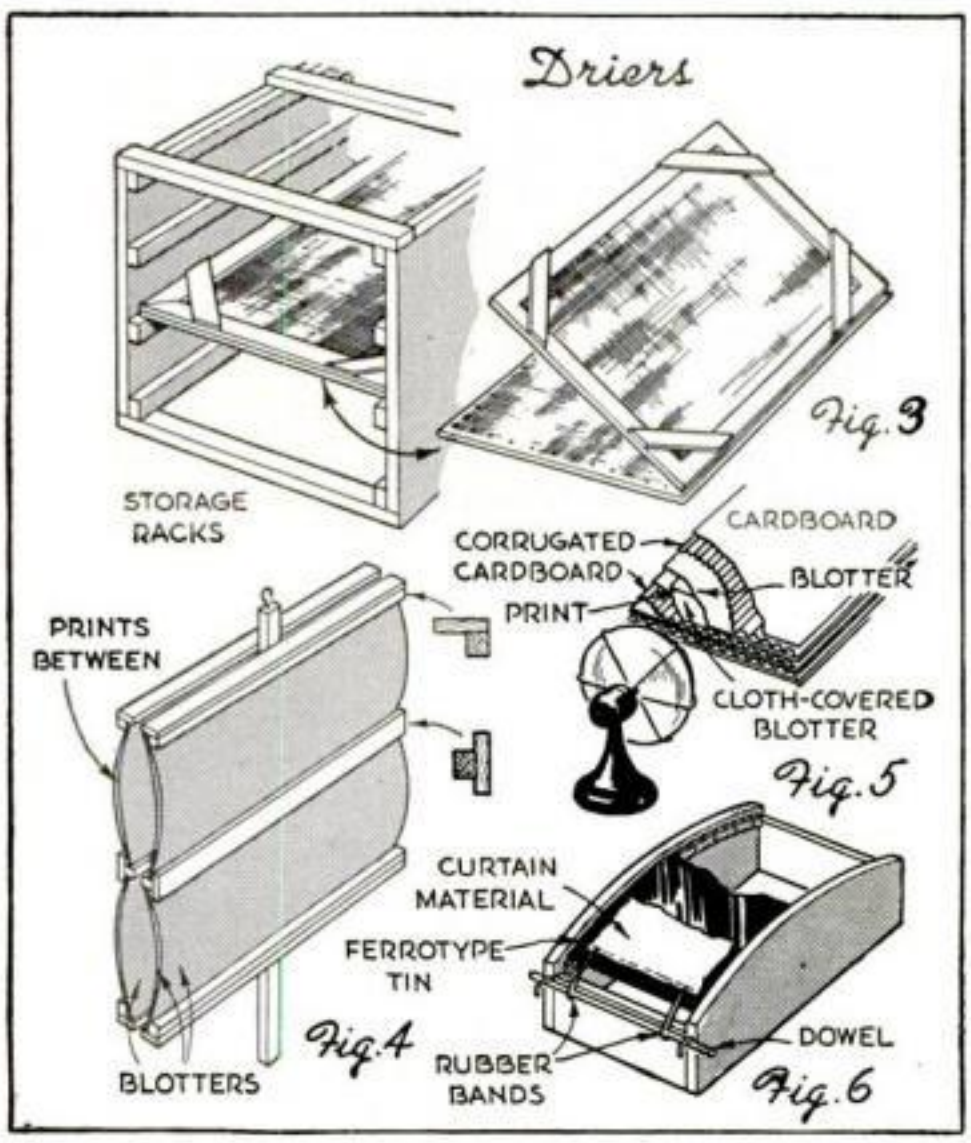
Before attempting to dry prints, place a piece of plate glass or an old automobile windshield slanting in your sink. Put a number of wet prints face up on the glass, and with your rubber roller or squeegee expel as much water as possible. You can now take these prints and lay them on your drying racks, or, if you are pressed for time or distrust the purity of your water supply, you can first use a clean cellulose sponge to wipe the face and back of each print.

Drying. There are numerous methods of drying prints. Devices for this purpose range all the way from a clean towel to elaborate automatic machines. The amateur will find any of the following methods satisfactory for drying nonglossy prints:

1. Lay the wet prints on a clean towel or a sheet that is free from lint. 2. An old curtain or some white mosquito netting can be stretched between two chairs or bedposts. This has the advantage of letting air circulate freely around the prints, thus drying them more quickly. 3. One of the most practical and convenient ways of drying prints is the book method shown in Fig. 3. From light strips of wood make two frames, and cover them with lintless material, such as net curtains or strong cheesecloth, which will permit free circulation of air. These frames are hinged on the long side and the prints are placed between them. A number of these "books" can readily be stored overhead and out of the way in grooved racks. 4. Arrangements using photographic blotting paper are good, but don't attempt to use ordinary blotting paper. In one type of drier the paper is in the form of a double roll. The layer against which the emulsion side of the print is laid is covered with muslin, and the two layers are rolled up with corrugated cardboard between the turns. One advantage of this method is that the prints dry with a backward curl, but it takes more than two hands to manipulate a large roll.

Figure 4 shows a drying rack for use with blotters that will handle a small number of prints very efficiently. The photographic blotters are snapped between wooden crosspieces with the prints sandwiched between them. Drying is especially fast if the drier is suspended from the ceiling of a warm room.

Another form of drier is the blotter book. Photographic blotting paper is cut into suitable sheets and stacked between corrugated cardboard, as shown in Fig. 5. Half the blotters are covered with muslin, and prints are placed face down on these. Forcing air



CROPPING. This is an art that depends entirely on the eye and taste of the individual. The print of the fisherman and the vast expanse of water above is attractive without trimming, but turn to the frontispiece of this article and compare the effectiveness of cropping along the lines suggested

through the stack with an electric fan speeds drying greatly.

The direct application of heat is another method of quickly drying a small number of prints. Many efficient electric driers are on the market. A simple one especially good for drying glossy prints can be made as in Fig. 6. The print is rolled face down for a glossy finish or laid face up if it is on mat stock. The entire unit can be placed over a radiator or an electric heater.

To ferrotype a glossy print we need either chromium-plated or enameled plates. The surface against which you squeegee the face of the print must be absolutely clean. Wax plates occasionally with the following solution, especially the black-enamel type:

Paraffin shavings	10 grains
Benzine	1 oz.

Apply a few drops of this solution to your ferrotype plate and spread it over the entire surface as thinly as possible. Polish with a lintless cloth; then flush off with cold water. Squeegee the print face down on this wet surface and remove surplus water. If all goes well, your print should drop from the ferrotype plate of its own weight when dry. The print surface should show a high gloss free from all "oyster shelling." If you find such cracks around the center, you can be sure they are due to uneven drying. The outside margins dry more rapidly than the center, leading to uneven expansion, and artificial heat will aggravate the condition. Covering the wet print with a larger piece of dry or damp paper is helpful (Fig. 7).

No matter how you dry your prints or how flat they appear when taken from the drier, they will always curl up in a short time because the surface tension of a piece of photographic paper is unequal on its two sides. A water-and-glycerin solution sponged on the back is of some help, but the best thing to do is to mount your good prints permanently.

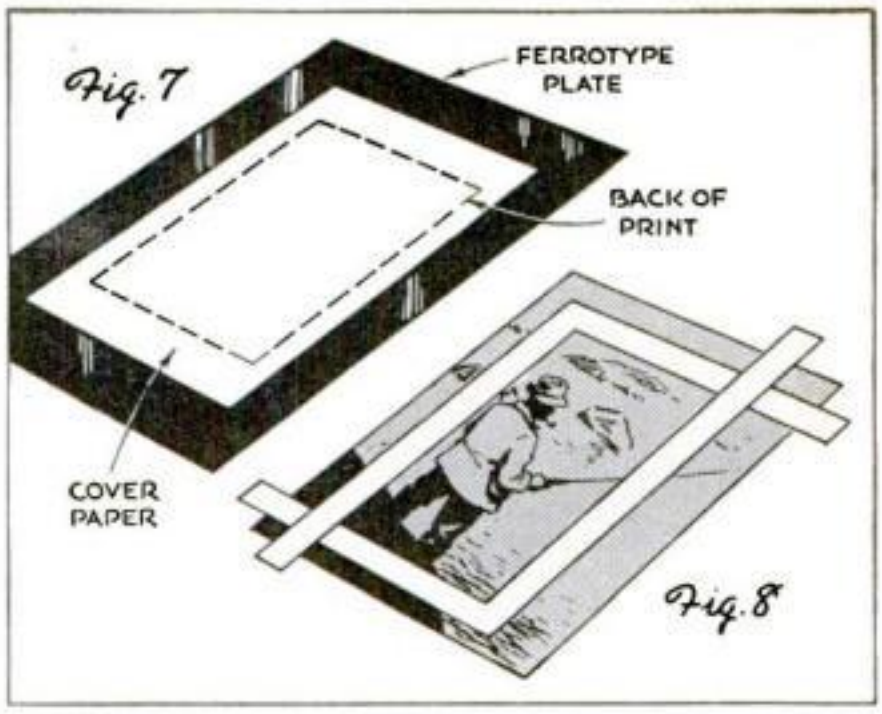
Cropping. If no trimming board is available a metal straightedge, together with a good, sharp paper-cutting knife will do. Use a piece of zinc to cut your mats on, or some of the hard composition boards may be used. If you can't decide how to trim your print, frame various parts off with two L-shaped pieces of cardboard (Fig. 8). These will give you an idea of what the trimmed print will look like and what cropping will afford the best composition. Be

sure your trimmer is adjusted to cut squarely. After you have made the first cut, proceed by cutting the next adjoining side, putting the trimmed side against the ruled stop, and so on.

It would be highly desirable to have standard mount proportions established by some national or international photographic society. In the absence of such standards, a 16" by 20" mat is a good one to use, as most exhibitions in this country require this size. If you don't expect to submit your prints to salons, the size of your mat becomes a matter of personal choice, but remember that a good proportional relation between print and mat is of the utmost importance. You cannot go far wrong if you keep the top and the two side margins equal, leaving the bottom one much wider.

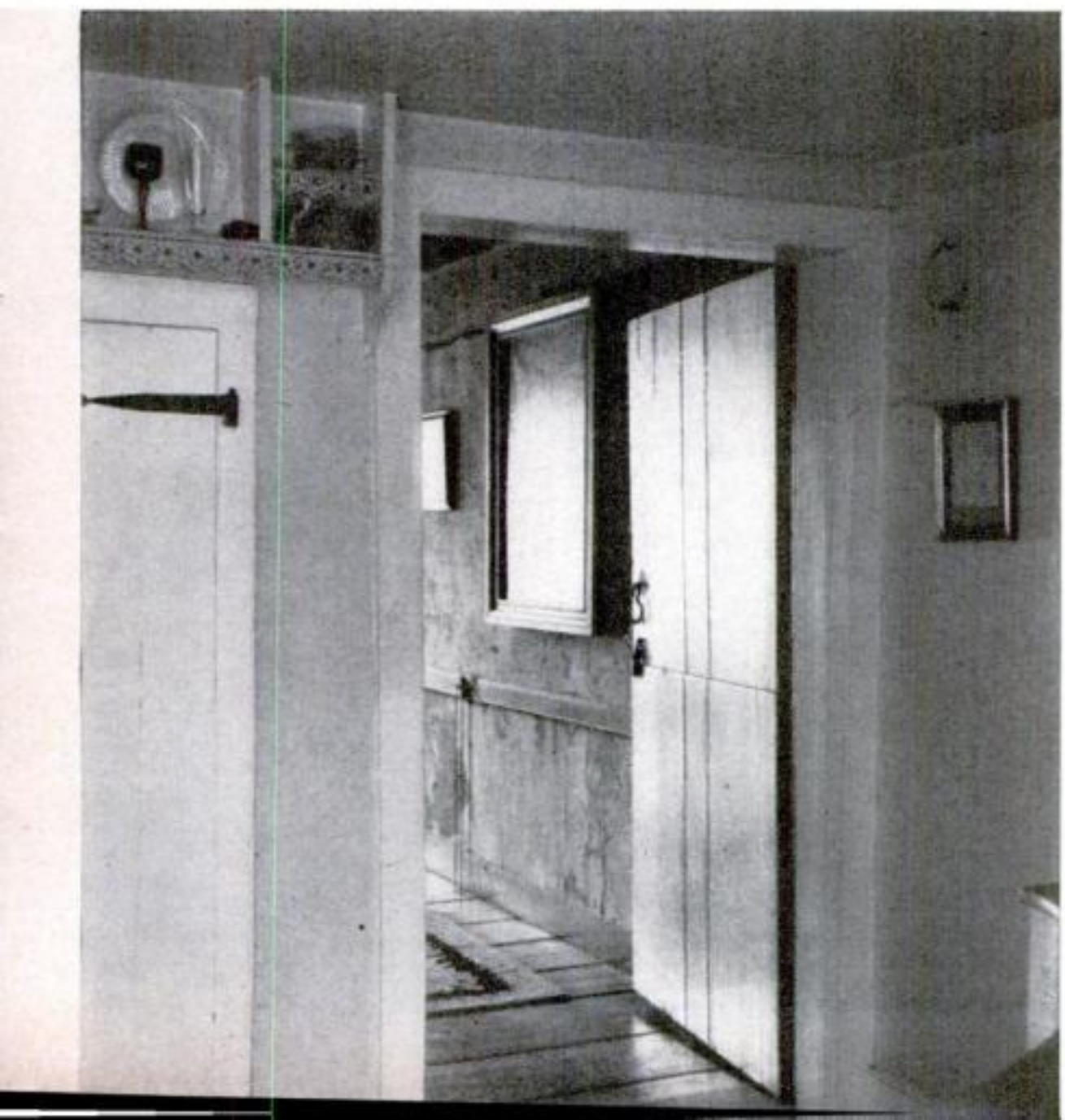
There are a great variety of mat boards on the market. Use a pure rag stock whenever possible, as this is the only material that will not turn yellow and fall to pieces in a few years. Some boards have thin sheets of rag stock covering a wood-pulp core. This is not a very permanent material. It is better to use a thin stock that is pure. A thin backing also saves space.

There is no doubt in the writer's mind that the surface and color of the mount should be plain. All artificial surfaces such as antique printing, imitation linen surfaces, deckle edges, as well as what I call "mouse-bitten" edges, are out of keeping with the purpose of a mount, which is to form a neutral background that shows off the print to best advantage. The color of the mat should be just sufficiently off white to produce a tonal contrast with the whitest white in the print. Colored or strongly tinted mats are taboo in good photographic circles. Of late, fairly simple, ready-made mats of the slip-in type have appeared on the market.



Cover papers (Fig. 7) help prevent cracking. Two L-shaped frames will aid in deciding on cropping

Another example of cropping. Here what might be considered extraneous detail at left and right in the print is cut away, and the top and bottom trimmed down for symmetry. The effect of cropping is easily studied in advance by using the L-shaped pieces of cardboard to frame the subject in a variety of ways



IDENTIFICATION PHOTOS

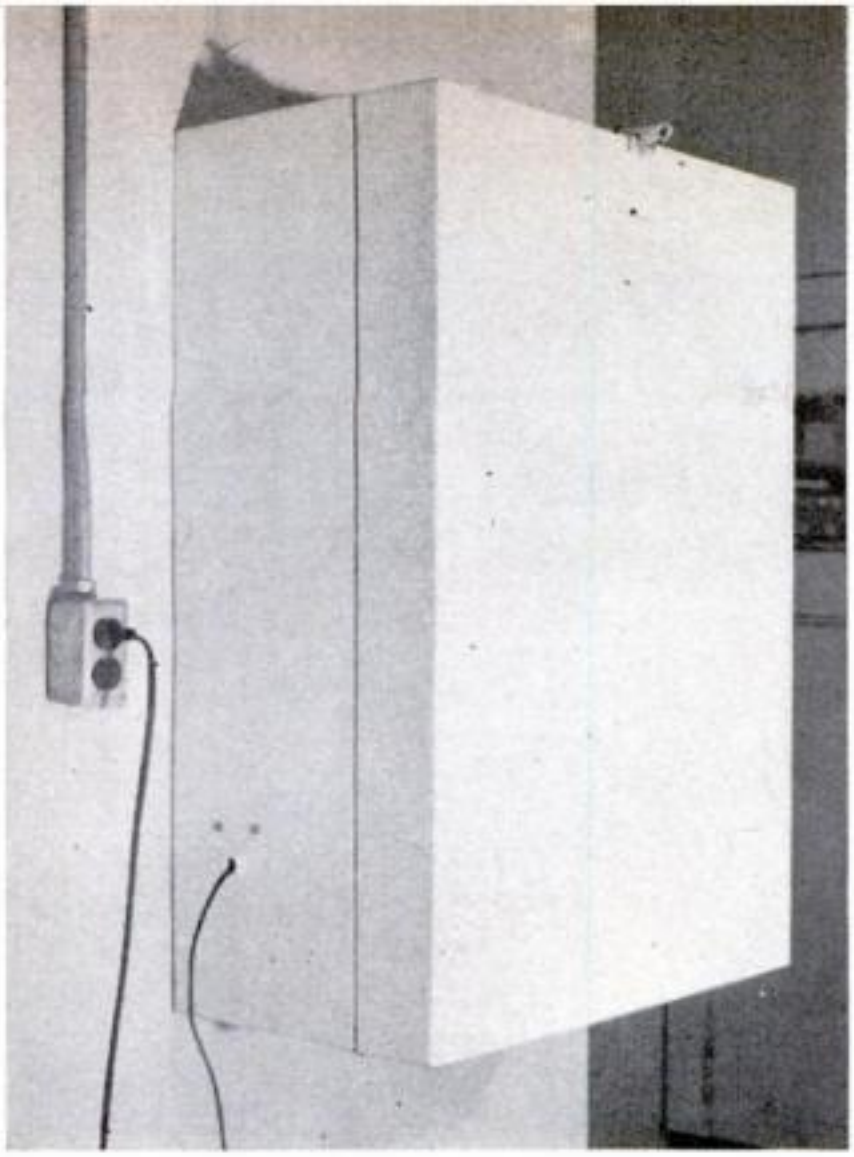
Speedily Taken with Low-Cost Outfit

THE war has caused a tremendous increase in the use of photographic identification badges. Manufacturers with war-work contracts are required by the Government to provide such badges for all employees, and various voluntary organizations are also using "passport" photos in large numbers.

To take photos of this type it is usually necessary either to install special equipment, which costs several hundred dollars, or engage a professional photographer, which is expensive and often results in considerable waste of time, or have each individual obtain his own photo at still greater expense and with a resultant lack of uniformity. The problem can, however, be solved by building an outfit like that illustrated. It was constructed by the Columbian Steel Tank Company, of Kansas City, Mo., at a cost of less than $30 except for the lamp stands, which were borrowed from the company dispensary.

The heart of the unit is an inexpensive reflex camera. The cabinet is steel, but could be plywood. It is 36" high, 24" wide, and 14" deep, with a drop lid 4" deep. Across the lid, as shown above, is a platform 13½" wide on which is mounted the camera bracket, which is 10" high. A centered vertical slot permits vertical adjustment of the camera, and there are holes on 2½" centers for horizontal adjustment. A mounting clip is provided, and it has slots so that the camera

Photographs for the purpose of identification are obligatory in many manufacturing plants and are often required for civilian purposes This one was taken with a homemade unit



Folded against the wall, above, the identification camera takes little space. At left, it is put to use. Up to 75 photos an hour can be made

Turned upside down, an ordinary reflex camera forms the basis for the setup. Once adjusted on its mount, it needs no other manipulation. It is used inverted in order to facilitate changing film rolls

may be anchored to it upside down by means of the regular lug for the flash attachment and the two screws for the carrying cord.

The lens should be not less than 28" from the subject, and a portrait attachment can be used if desired. Inverting the camera makes it unnecessary to fasten the catch on the loading mechanism.

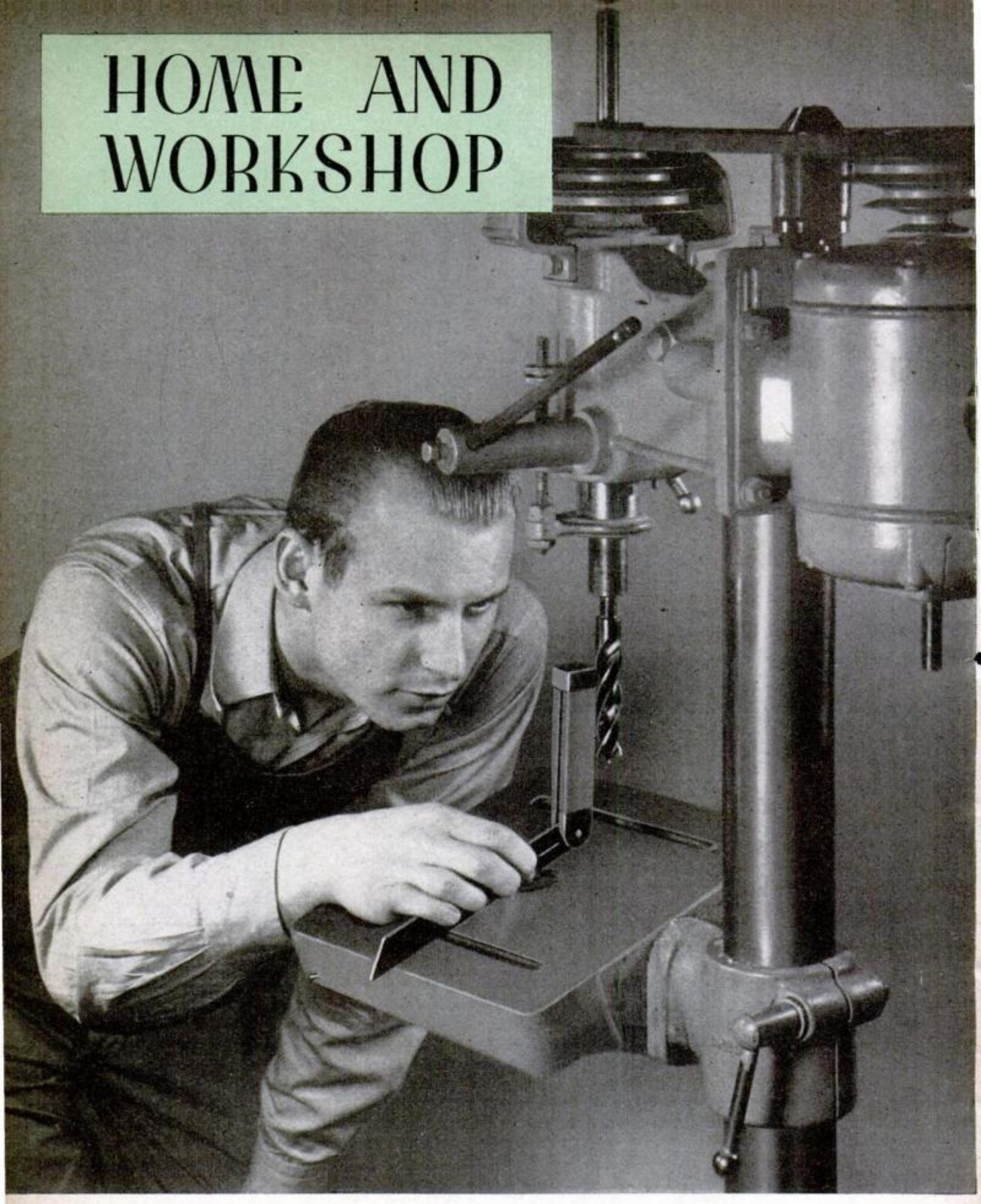
At the other end of the drop front is mounted a removable viewing frame of ⅜" rod, 17½" high by 23" wide, with a 1½" offset at the mounting slots. The base of the cabinet should be about 40" from the floor.

The subject is seated on an adjustable stool before the viewing frame with his chest against the edge of the drop front. Identification numbers may be placed at the lower edge of the frame. A white window shade is a suitable background, and two photoflood lamps are required. A fast film is used at "instantaneous" exposure, which eliminates any possibility of blurred shots due to movement on the part of the subjects.

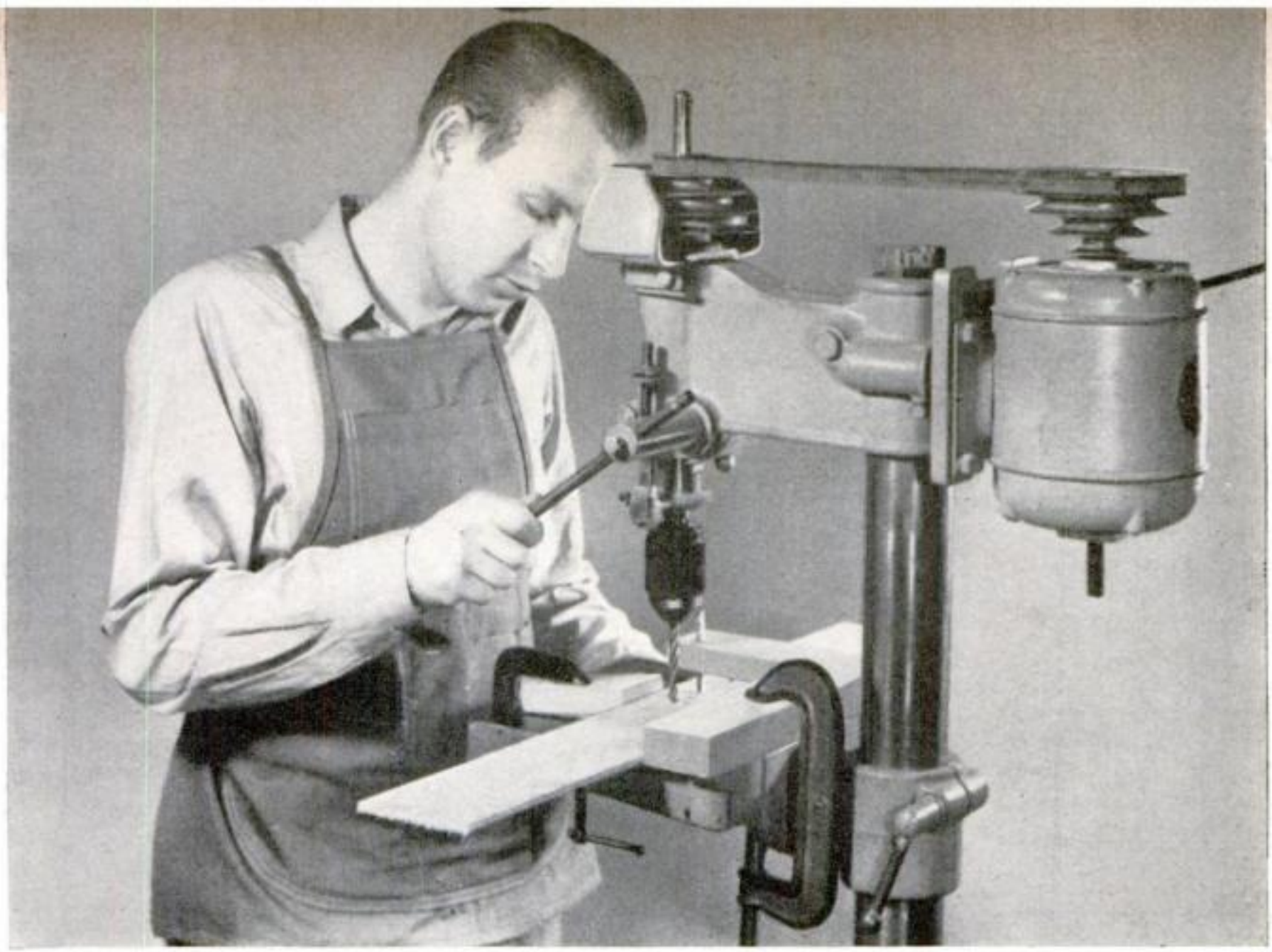
The negatives may be masked to provide 2½" by 2½" prints, which can then be die-cut, if necessary. The negatives themselves may be retained in a master file. In regular operation it should be possible to make from 60 to 75 photographs an hour at a cost of less than seven cents each.

At left, the photograph on the facing page die-cut to fit into a badge; and, at right, framed in the badge. Masking the negative to get a 2½" by 2½" print will be a help in obtaining a size to suit the average badge

HOME AND WORKSHOP



A DRILL PRESS ADDS EFFICIENCY TO THE WOODWORKING SHOP. HERE THE TABLE IS BEING CHECKED FOR BORING AT AN ANGLE



Holes are spaced evenly by a dowel pin that slides in a fixed block and engages each preceding hole

The DRILL PRESS– its uses in woodworking

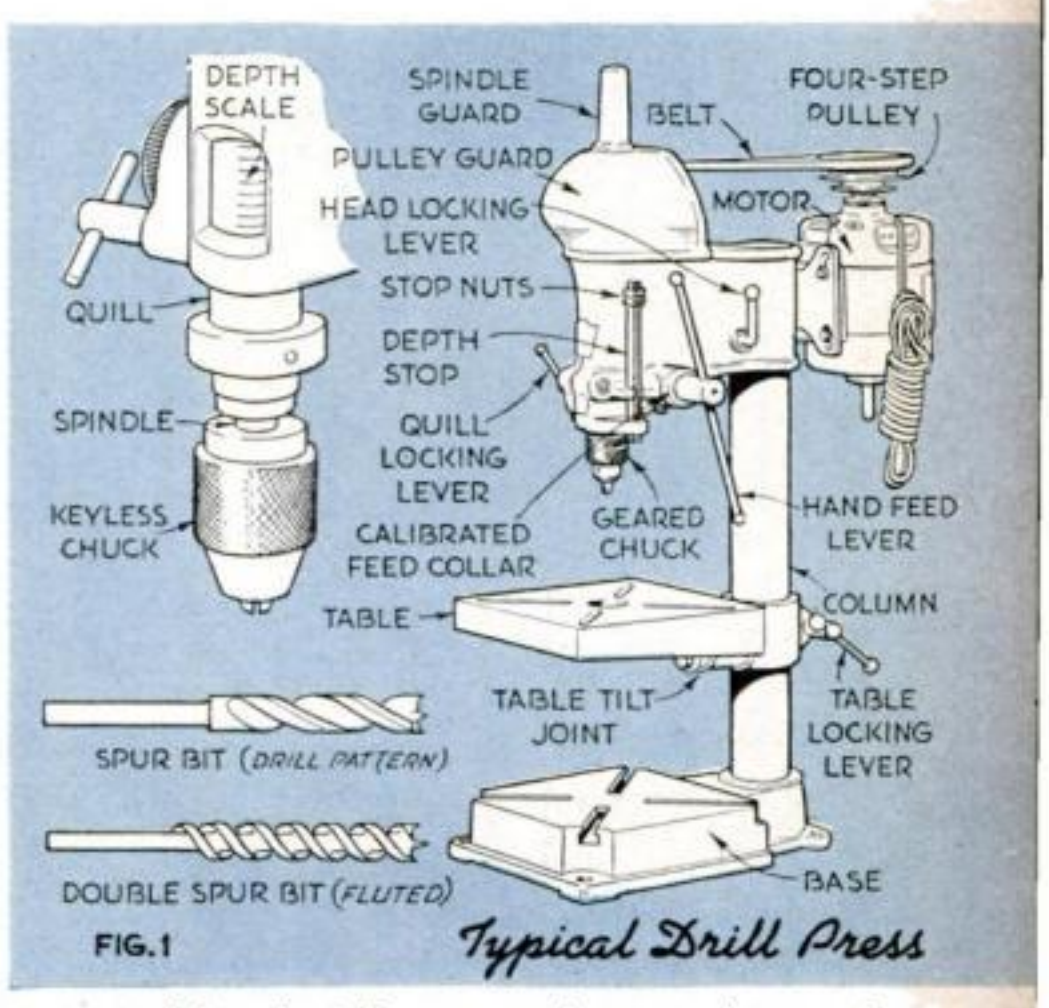
By EDWIN M. LOVE

IT MIGHT be supposed that a drill press would be of limited usefulness in the woodworking shop, but actually it is one of the most efficient timesavers among power tools. It may be used to bore, rout, shape, mortise, sand, carve, cut dovetails, and make dowels, as well as for drilling and grinding metals.

Not only is work done more quickly on the drill press, but it is also highly accurate. Work is held at precisely the correct angle to the bit, and can be clamped to make slipping impossible. With auxiliary fences, guide blocks, and tables much layout work can be eliminated, as holes can be spaced mechanically.

How is a drill press set up? Assembly consists usually of slipping the head over the end of the column and bolting on the motor. Be sure the latter has ball bearings if it is to be used in a vertical position. Align the pulleys and tighten the belt just enough to prevent whipping.

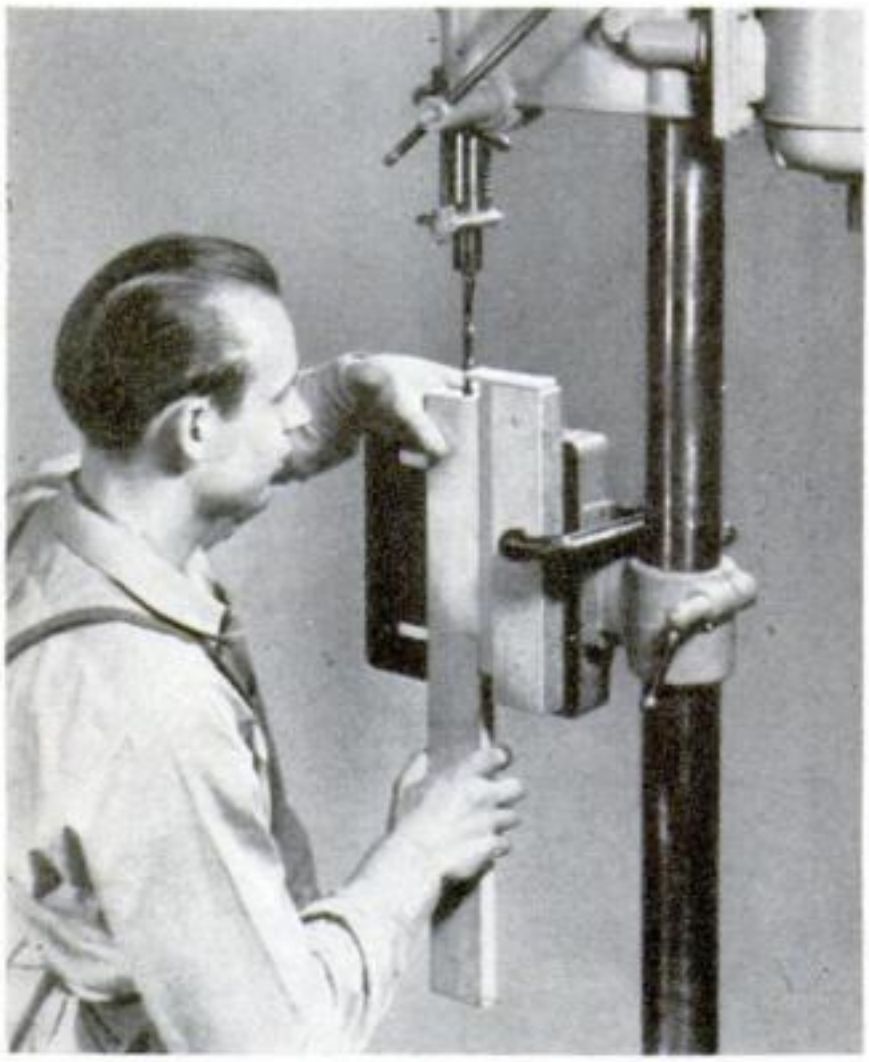
Although a bench-type drill press of the



A typical bench drill press and nomenclature of its principal parts. At lower left, twist-drill type bit and fluted brad-point bit for boring in wood

kind shown in Fig. 1 is often bolted down, portability is an asset, and if the machine has a heavy base it can be used unbolted. A floor-type drill press is also best left unfastened.

What bits are used for boring in wood? There are several kinds on the market. The best for use in the home shop are machine spur bits resembling twist drills, but having brad points and spurs (Fig. 1). The double-twist fluted bit shown cuts rapidly and smoothly. Ordinary twist drills are satisfactory for boring small holes, but in the larger sizes tend to produce slightly oversize and oval-shaped holes.



A stop block on top of the fence limits depth of dowel holes in a rail end as the work is pushed up

Ordinary auger bits can be used if the square portions of the shanks are cut off and the feed threads filed from the points. Such bits must be used at low speed, as they seldom run true.

How are holes bored with the drill press? For holes through the flat or edge of the stock, the table is used in the horizontal position. If the hole is to be bored clear through, use a waste block under the work to reduce splintering at the bottom edges, and swing the table so that the bit can pass through the center hole, or else set the depth-stop nuts to prevent the bit from touching the table. Holes can be drilled to a predetermined depth by observing calibrations on the stop screw, quill, or feed collar, or by setting the stop nuts. Set the lower one first and lock it by turning the upper one tightly against it.

Can a drill press be used for boring holes at an angle? It can, if it has a tilting table. Set this to the desired angle and clamp on a stop block to prevent the work from sliding downward. If the shape or size of the work makes this impossible, cut an angle block or a special fence, as shown in Fig. 2, to hold the work in the desired position.

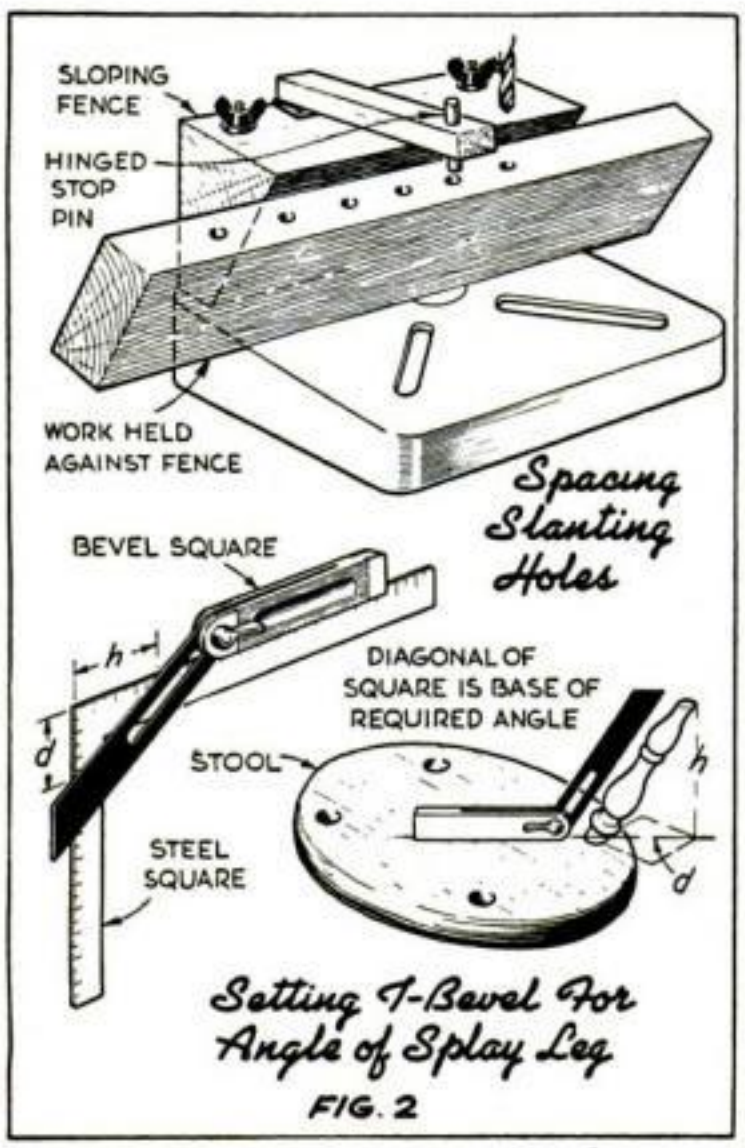


FIG. 2

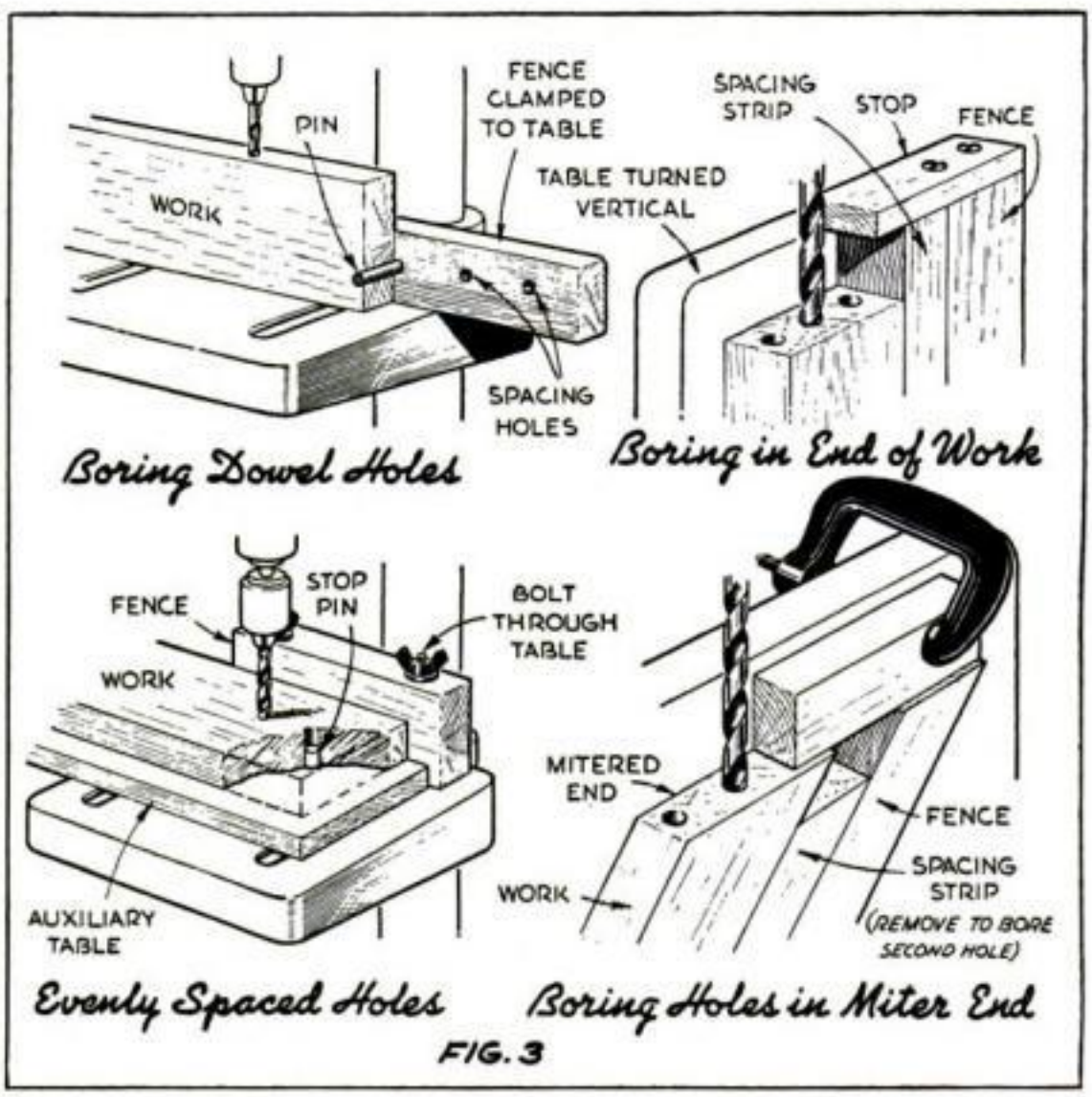


FIG. 3

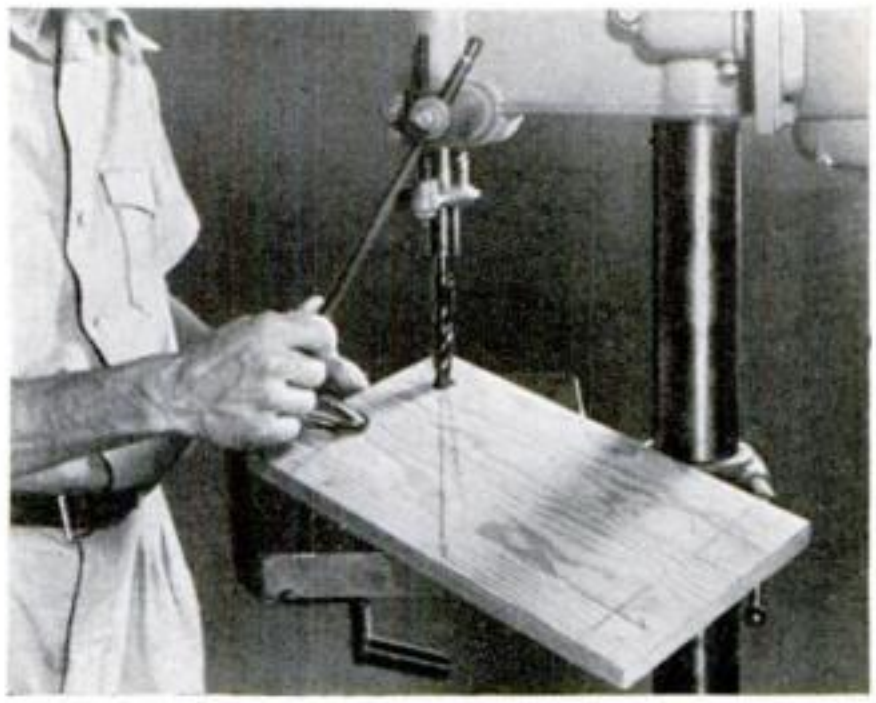
How is the drill press set for boring holes that slant two ways? Plans usually specify the inclination in inches. The splayed legs of a stool, for example, may have a slant of 3″ in 8″. The angle of the hole obviously has for its base the diagonal of a square 3″ on a side (see Fig. 2). Set a T-bevel as shown in the drawing, and use it to set the table. The diagonal of the work must be parallel to the tilt of the table if an equal flare in both directions is wanted.

How are dowel holes bored? Those in edges are bored with the face side of the work against a fence, and dowel pins can be used to space them, as shown in Fig. 3. End holes in short pieces can be bored with the piece held upright. Similar holes in long pieces are produced by tilting the table vertically, or using a jig with a vertical face and swinging the table to center the bit (Fig. 3). Clamp on a vertical fence to hold the stock perpendicular, lock the quill, and slide the work up against the bit. Since two holes are usually needed, it is best to bore the first with a parallel strip between the fence and the work, and the second after removing the strip. This provides automatic and exact spacing.

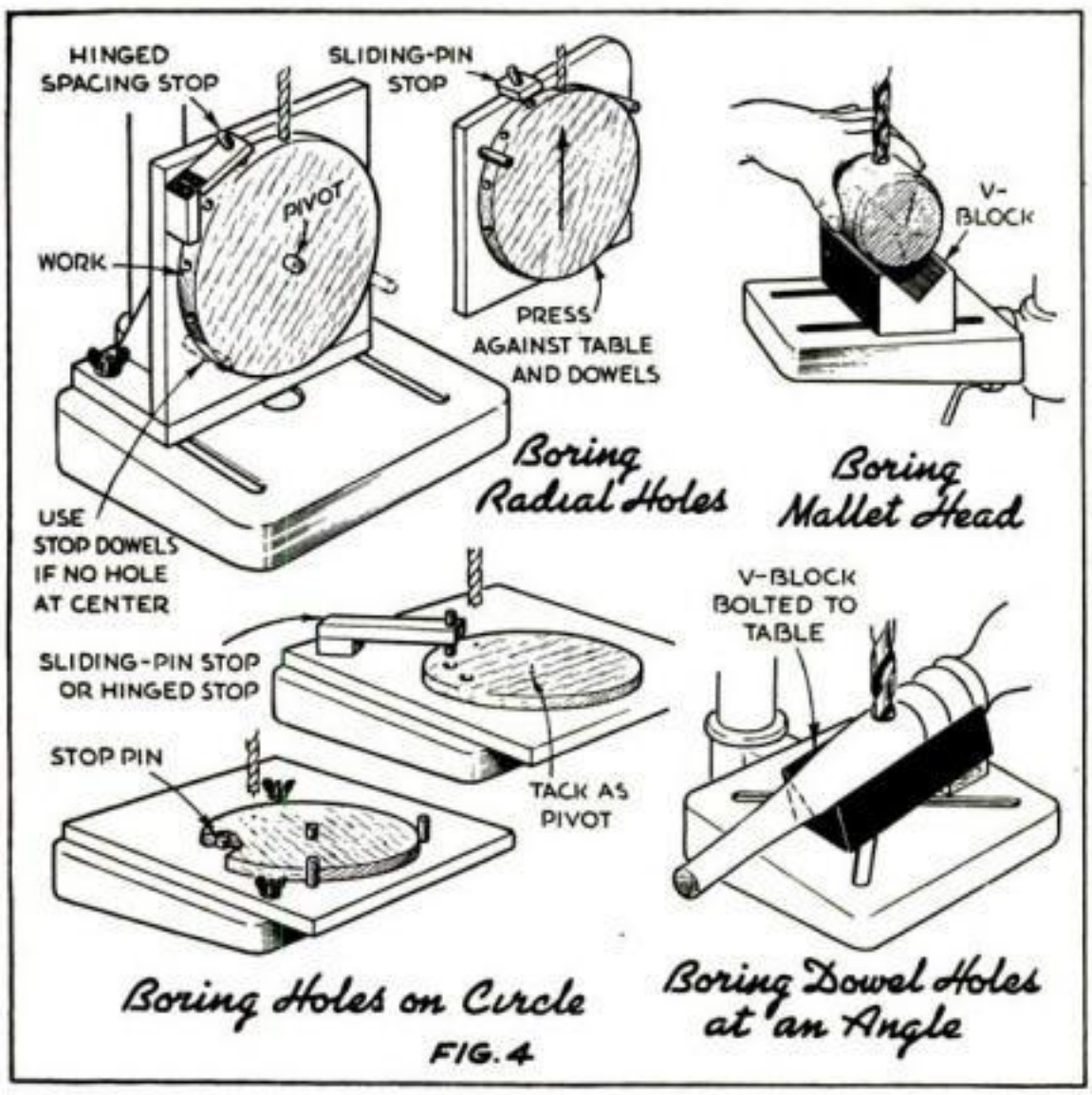
A set-up for drilling dowel holes in miter joints is also shown in Fig. 3. This method spaces the holes with absolute accuracy and is a great timesaver.

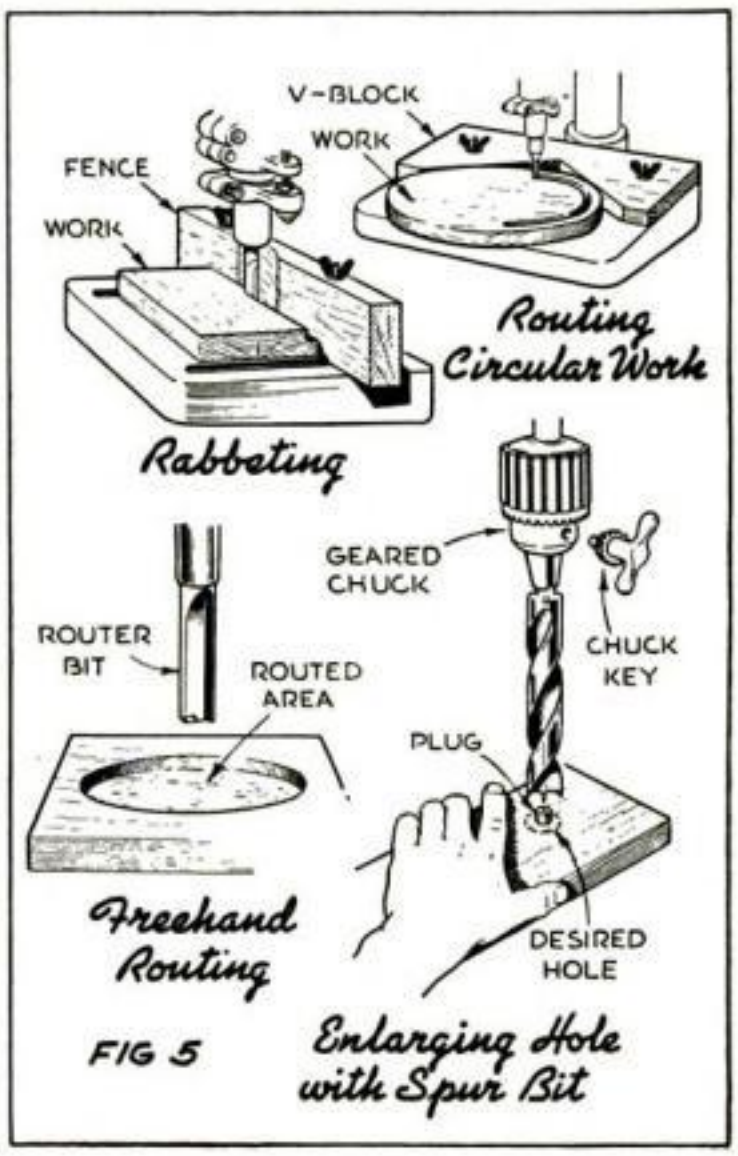
How are holes bored in spindles and radial work? When a tenon hole must be bored in a turned spindle, support it on a V-block (Fig. 4). Radial holes in the edges of disks or the side of a cylinder can be bored by mounting the work on a pivot set in an auxiliary vertical table, or by thrusting the work against a couple of dowel pins suitably placed. Both methods are shown in Fig. 4. Various spacing stops can be devised, but trials should be made on waste wood before drilling is begun on the work itself.

What is routing, and how is it done? Routing is the process of scooping or milling out an area in a piece of work, such as the background of a carving or grooves for inlays. Router bits (Fig. 5) are of special design and come in various sizes. For home-workshop machines they are designed to cut



Boring for a splayed leg. Note that the diagonal line coincides with the center of the tilted table





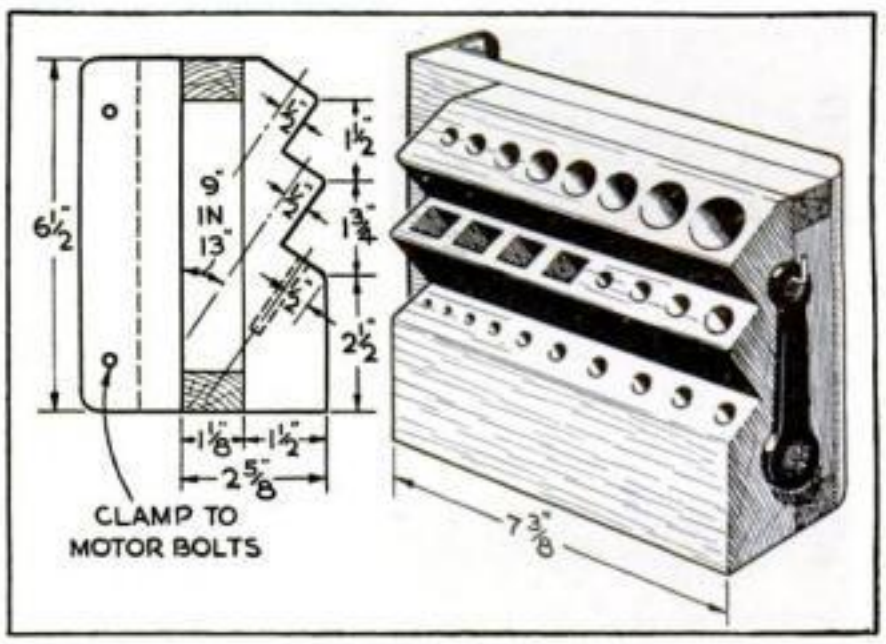
In routing a groove on the drill press, a straight or curved fence is used for guiding the work. The router bit is lowered into the stock, which slides along the fence. Make several cuts for deep grooves

only ⅛" deep. If the area to be routed extends to the edge of the work, set the table at proper height for the depth of cut desired, lock the quill, and feed the work against the cutter. The drill press should run at its highest speed. If the routing is all inside the edges, start by feeding the bit down as in boring, and lift it out when the cut is finished. Take two or more cuts for deep routing. Grooves are easy to make with a bit of the proper size. Use straight or curved fences, as required (Fig. 5). Disks can be pivoted or held against a V-block as shown. Be sure to hold the piece firmly down against the table, as the least lifting will cause marring of the bottom surface.

Rack for Drill-Press Bits Forms a Good Practice Project

IF YOU'RE learning to use a new drill press, what could be more appropriate than making this rack? It is easily attached to the motor bolts on the drill-press head, and will hold several woodworking bits, mortising chisels, and twist drills of the most frequently used sizes.

On the circular saw, rip out the stepped face block at the angle shown. Tilt the table of the drill press to the same angle by using a T-bevel, and clamp on a fence to hold the work against. Drill each hole with the bit it is to fit. Build up the body as shown so that it will not warp, and attach a metal mounting bracket.—E. M. L.

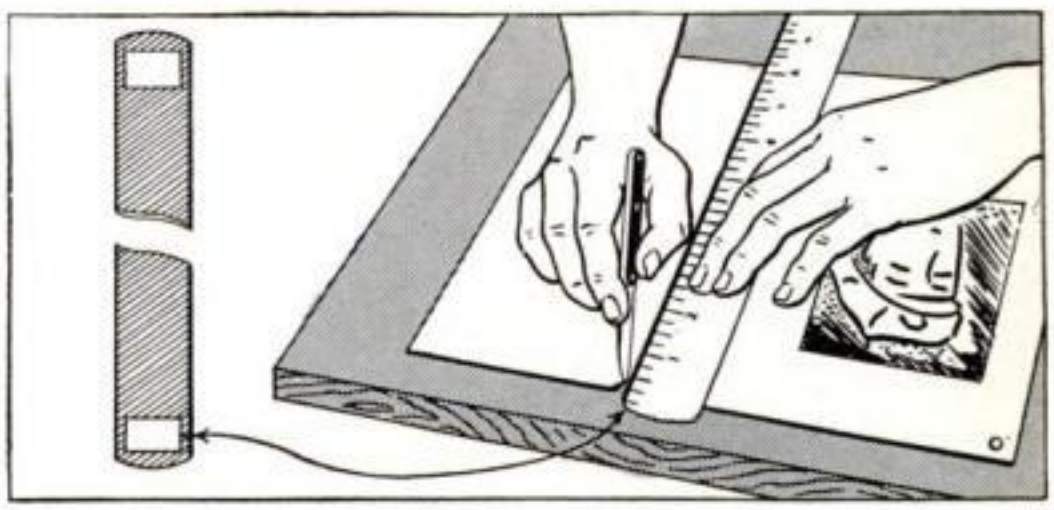


Rubber Hose Pieces Pad Bicycle "Kick Stand"

CHILDREN frequently kick their bicycle stands up or down when they are at play with little regard for the wear they put on shoe leather or the damage done to its neat appearance. However, this shoe scuffing can be prevented, or at least lessened, by providing a rubber pad for the "kick stand." Cut from an old piece of ⅝" garden hose eight or nine 1" lengths, depending on the size of the bicycle stand, and slip them over the rod one at a time. Divided into small sections in this way, the hose easily goes over the bend at the foot of the stand. Put on enough sections to cover the metal from the bend to the top.

Pieces of Sandpaper Anchor Straightedge

WHEN large pieces of cardboard have to be trimmed or mats cut, the straightedge can be kept from slipping by a small piece of fine sandpaper pasted face out under each end. This helps also with smooth templates and other guides.—PAUL R. LONGNECKER.

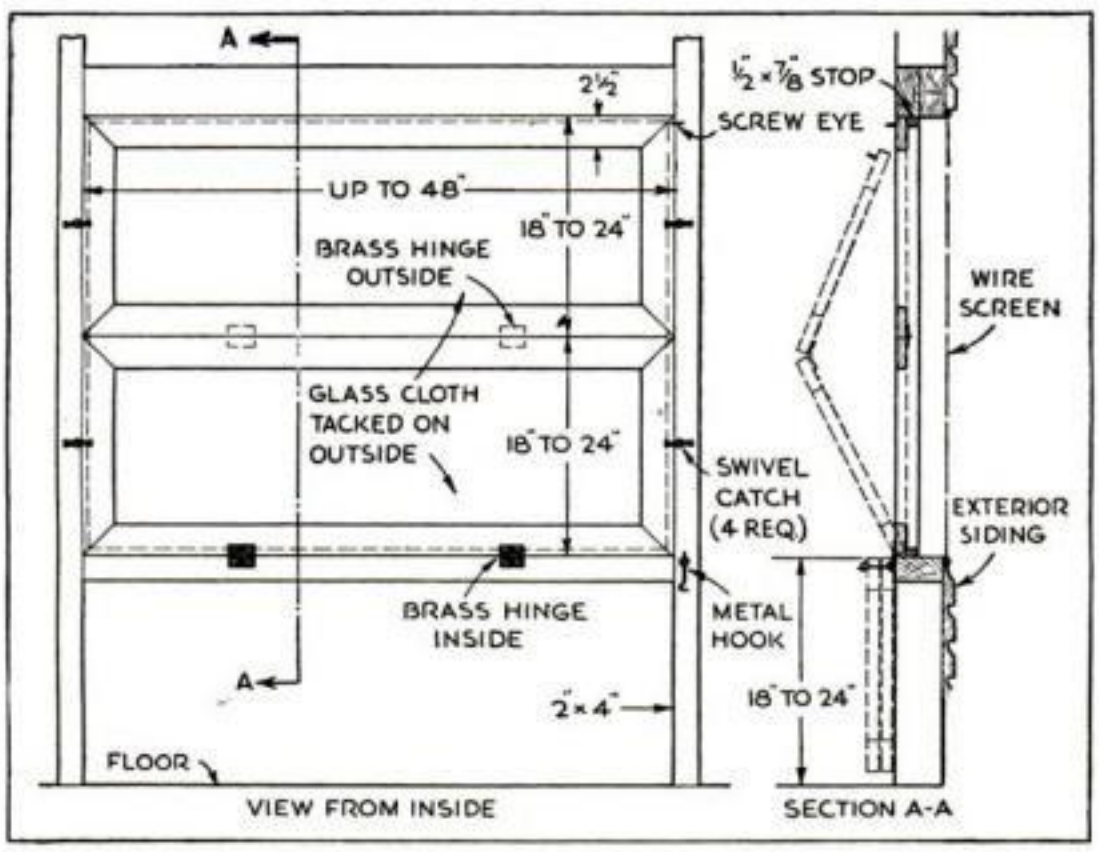


Easily Installed Storm Sash Forms Inclosure for Porch

A PORCH can be transformed into a sleeping room, free from drafts and rain, by raising these easily made folding sash frames. They fold flat against the wall when not in use, and are translucent enough to let in daylight.

In openings more than 48" wide, fit a center stud and make two sashes. Nail ½" by ⅞" strips in each opening ⅞" from the inner face to form a rabbet all around. Miter the corners of the frames and join with splines and waterproof glue, corrugated fasteners, or small angle brackets. Cut cellulose or paraffin "glass cloth" to size. Tack it on the outside.

Place each pair of frames in position. Mark the location of the hinges, and screw the middle ones on outside, the lower ones inside. Attach four metal swivel catches to the studs to lock the sash in place. Insert a screw eye at an angle on the upper frame, and a hook to engage the eye on one stud, to keep the sash against the wall when down.—R. M. DUNBAR.



Painting Outdoor Furniture

By MAURICE WHARTON

TODAY, when it is wise to use the family automobile as sparingly as possible, the garden and porch are more than incidental to the home—they may well become strategic centers of entertainment and relaxation. Boxes of flowers and shrubs, bamboo screens, fiber rugs, and other simple accessories, together with some lighting arrangement to extend the hours of enjoyment well into the evening, will transform a terrace, porch, or patio into an attractive outdoor living room during the summer.

The necessary furniture can easily be made by the home craftsman with the simplest of tools, or perhaps there is available substantial old furniture that needs only a touch of paint magic to restore it to brighter usefulness. Painting is, indeed, vital to its preservation if it is to be used outdoors. It is not hard to obtain a good, durable finish on porch or lawn pieces, but the wrong choice of finishing materials may prove costly in time, money, and effort.

The main problem in outdoor finishes has been chalking—the greater the content of white pigment, the more prone the finish may be to chalking. Ultraviolet rays in sunlight may cause ordinary paint to deteriorate rapidly. However, there are available durable sun-resistant enamels for use on exterior wood or metal surfaces, including porch and lawn furniture. These are made on an alkyd-resin base, and are not likely to chalk in a single season. They can be had even in pure white.

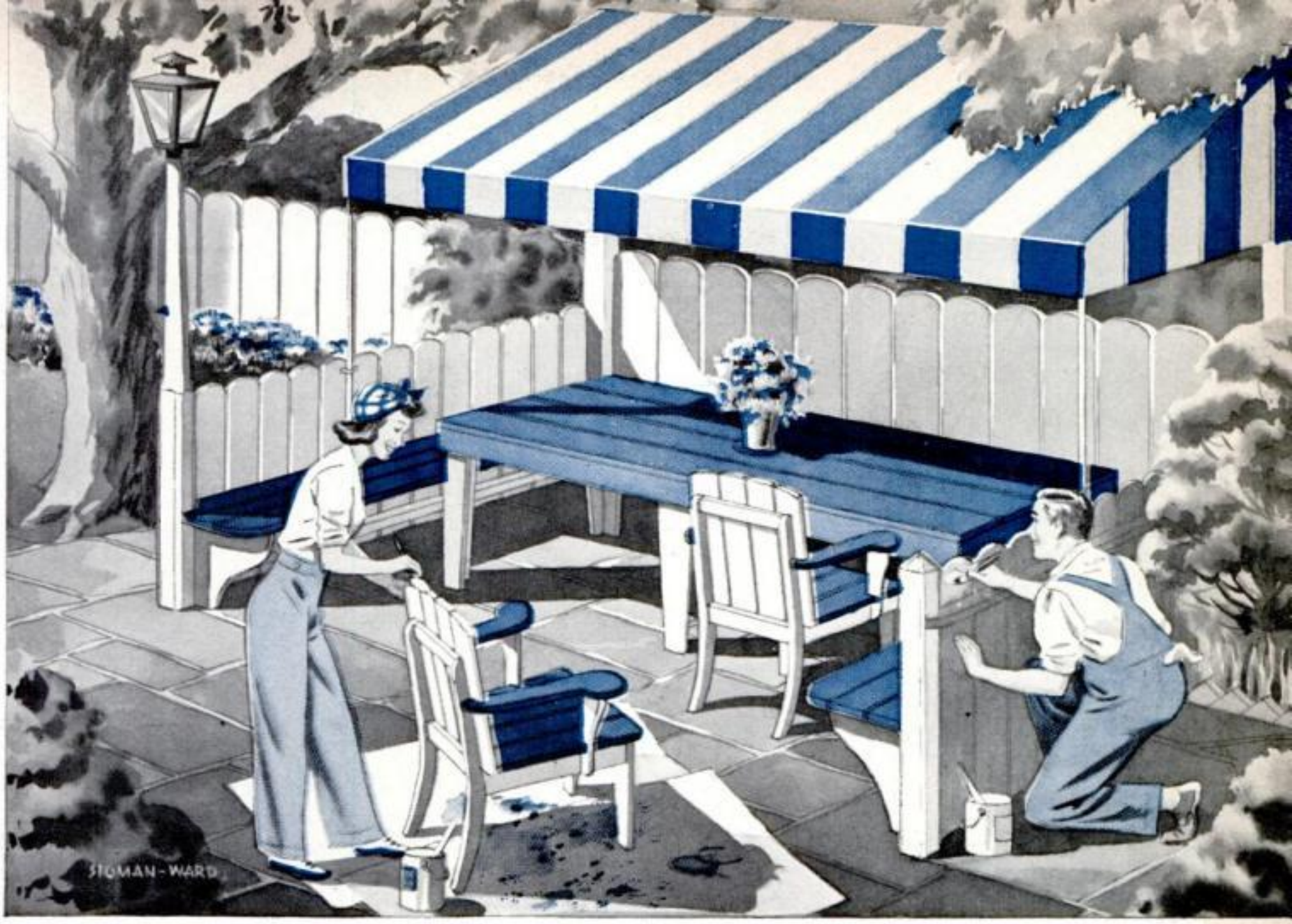
Proper preparation of the surface is important to obtain a smooth, porcelainlike finish, for the latter will be no smoother than the surface to which it is applied. Sandpaper the work thoroughly, dust it off, and wipe with a tack rag, if one is at hand.

On new wood or nonrusting metal, use an undercoat of the proper color and follow it with a coat of the exterior enamel, which should be used according to the manufacturer's directions. A flat buff undercoat is recommended for use under orange, yellow, cream, brown, or red. Use a flat gray under blue, green, or gray. On iron and steel, apply red lead, blue lead, aluminum bronze, or some other rust-inhibitive primer, and follow with a coat of the desired enamel. If two coats are used, sand the gloss off the first before applying the second.

Suggested Color Combinations

FOR PORCH AND LAWN FURNITURE

Body Color	*Trim Colors*
Black	Chinese red, Chinese yellow, lettuce green
White	Red, jade green, Bermuda blue
Light ivory	Bright orange, Chinese red, jade green, turquoise
Peach	Powder blue, lettuce green, Chinese yellow
Buff	Black, bright orange, Chinese red
French gray	Chinese yellow, red, delft blue, Chinese red
Powder blue	Bermuda blue, French gray, peach
Chinese yellow	Black, French gray, dark green
Lettuce green	Black, light ivory, red
Jade green	Black, light ivory, red
Lawn green	Red, light ivory, bright orange
Dark green	White, light ivory, Chinese red
Bright orange	Black, light ivory, lawn green
Chinese red	Black, light ivory, buff, delft blue
Red	Black, lettuce green
Turquoise	White, light ivory, Chinese yellow
Bermuda blue	White, light ivory, Chinese red
Royal blue	White, red, bright orange, Chinese yellow



Anticipation of pleasure in store adds to the fun of refinishing furniture gaily for an outdoor living room. Be sure that you use the right paint and apply it correctly, and your pieces will remain bright

An undercoat is not necessary on old work that is to be repainted, provided the old finish is in good condition. Simply sand it smooth with No. 00 sandpaper. However, if the old finish is flaking or chipped, it should be removed with paint remover or by scraping, and the same schedule followed as for new work.

If an old light finish is chalking but otherwise in good condition, wipe off the surface chalk and apply a coat of good exterior spar varnish. This may alter the color slightly, but it will preserve the finish against further chalking. If the furniture is exposed to sun and weather constantly, refinishing with automobile enamel is recommended.

Loose joints should be repaired before repainting is begun. Remove all old glue and sandpaper the joint surfaces until they are clean. If they fit loosely, wrap thin wood shavings around the dowel or tenon portions. Use only waterproof casein or resin glue.

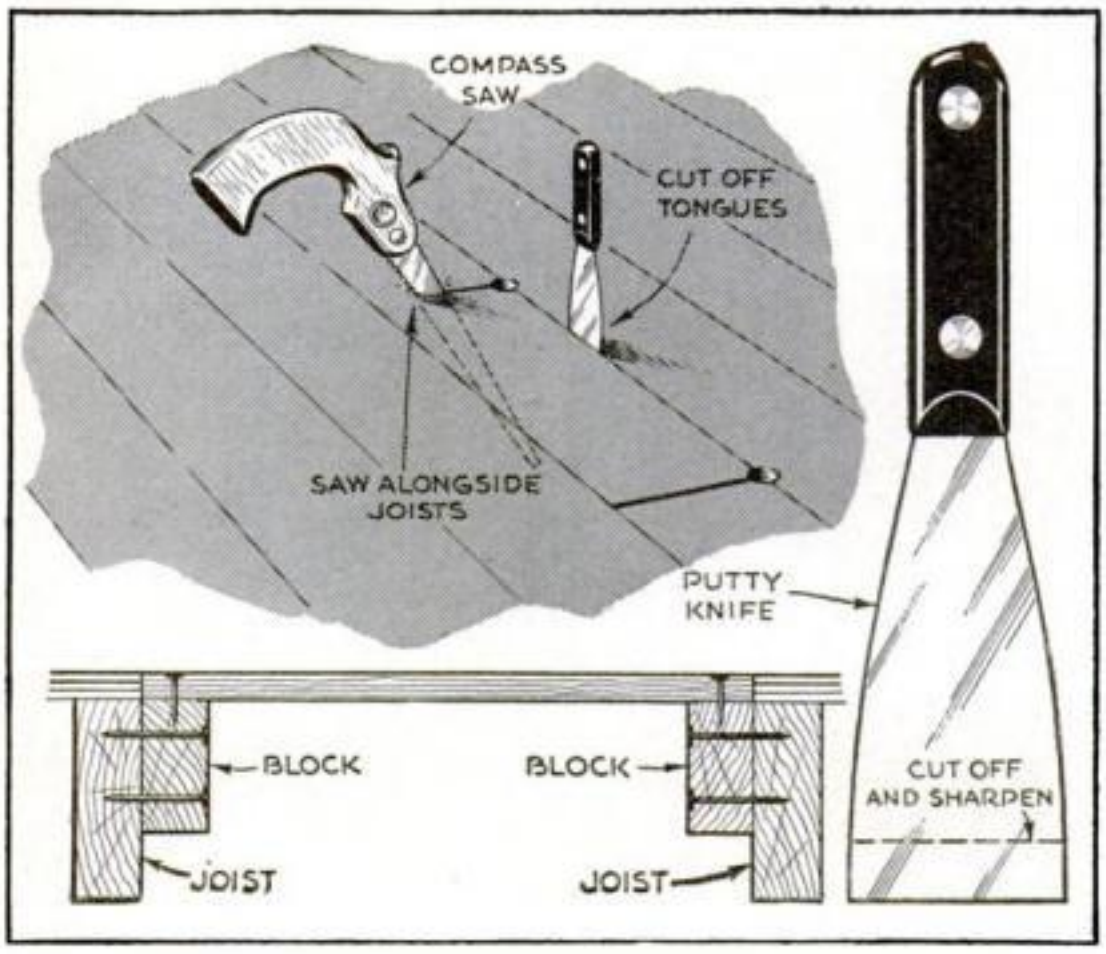
A spray gun may, of course, be used to advantage, but a really good brush will do satisfactory work. Always remember to paint the lower parts of a piece of furniture first. Chair legs and rungs can thus be painted conveniently while the chair is turned upside down on a table and a lot of bending will be avoided. Do the seat last.

For a natural wood finish on outside furniture, use an oil stain, followed by two coats of exterior spar varnish.

"Fiber" furniture on which the old finish is badly worn requires sizing before a new finish can be applied. Make up 8 oz. of casein glue with cold water and allow it to swell as for gluing; then add hot water to make 1 gal. of solution. This size can be sprayed, brushed, or swabbed on. Let it dry on the work in a warm room for about 48 hours, and apply enamel or varnish.

A spray gun is almost a necessity on work of this kind, as a brush piles paint up in the weave and wipes it thin on outside wearing surfaces. Even a hand-pump sprayer such as is used in the garden may be pressed into service. Spray as nearly parallel to the surface of the weave as you can, covering the same surface first from a left-hand position, then from a right-hand one. Two or three coats may be necessary to cover properly. Attractive two-color effects are possible by letting a ground color dry hard, then brushing on an overtone color and immediately wiping part of it off.

Putty Knife Is Aid in Lifting Tongue-and-Groove Flooring

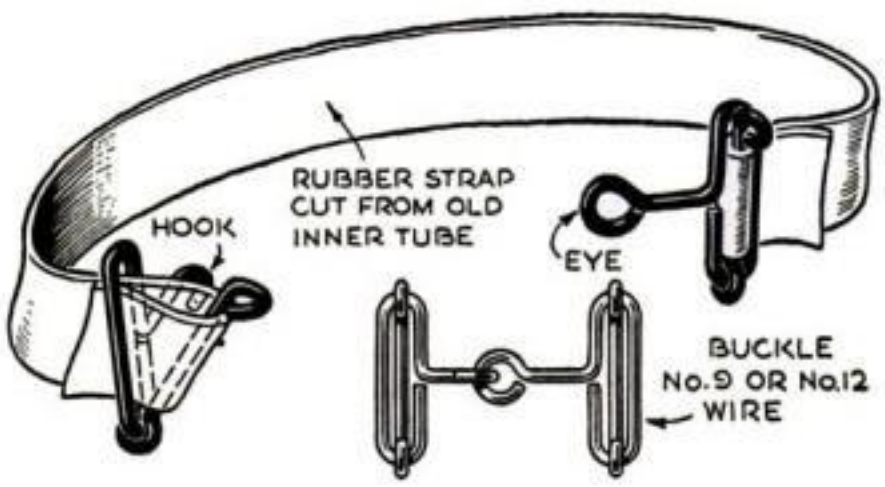


WHEN a section of tongue-and-groove flooring must be removed for access to wiring or pipes, a putty knife cut about 1″ short and sharpened to an edge as shown will be found a useful tool. Locate the two nearest joists by tapping the floor, bore a hole in the flooring alongside each joist, and saw the piece off with a compass saw. The sharpened putty knife is then used as a wide-bladed chisel to cut off the tongue of this piece and the adjacent one so that the sawed section will lift readily. In replacing the piece, nail blocks to the joists as shown in order to have a firm support. Plug the holes with corks or pieces of dowel.—EVERETT ZEIGLER.

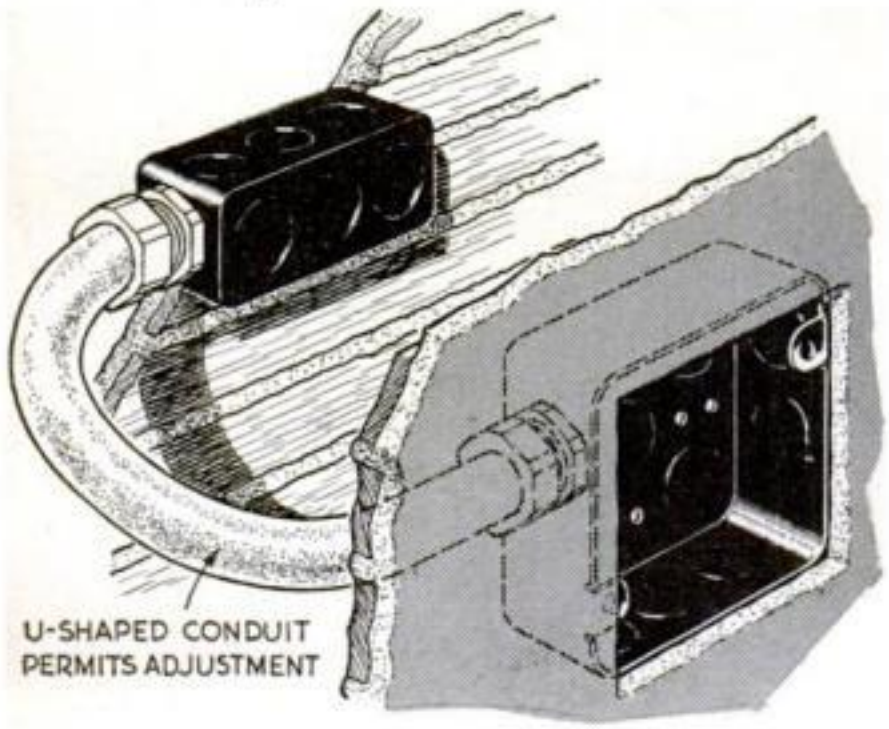
Sure-Grip Wire Buckle Holds Straps Cut from Inner Tube

USEFUL rubber straps up to 7′ or 8′ long can be cut from old automobile inner tubes, but heretofore they have not been of much use because it was difficult, if not impossible, to obtain a suitable buckle or fastener. The homemade buckle illustrated at the right, however, holds a rubber strap firmly and never slips under tension. It can be made out of No. 9 wire, or even wire as small as No. 12 for straps up to about 1″ in width.

To function properly, the loose end of the strap should be on the outside or uppermost in the buckle. If the strap is attached to the buckle any other way, it will not hold under tension. A hook and an eye link the ends together.—ALFRED NEUMAN.



U-Shaped Conduit Facilitates Setting Outlet Boxes Flush



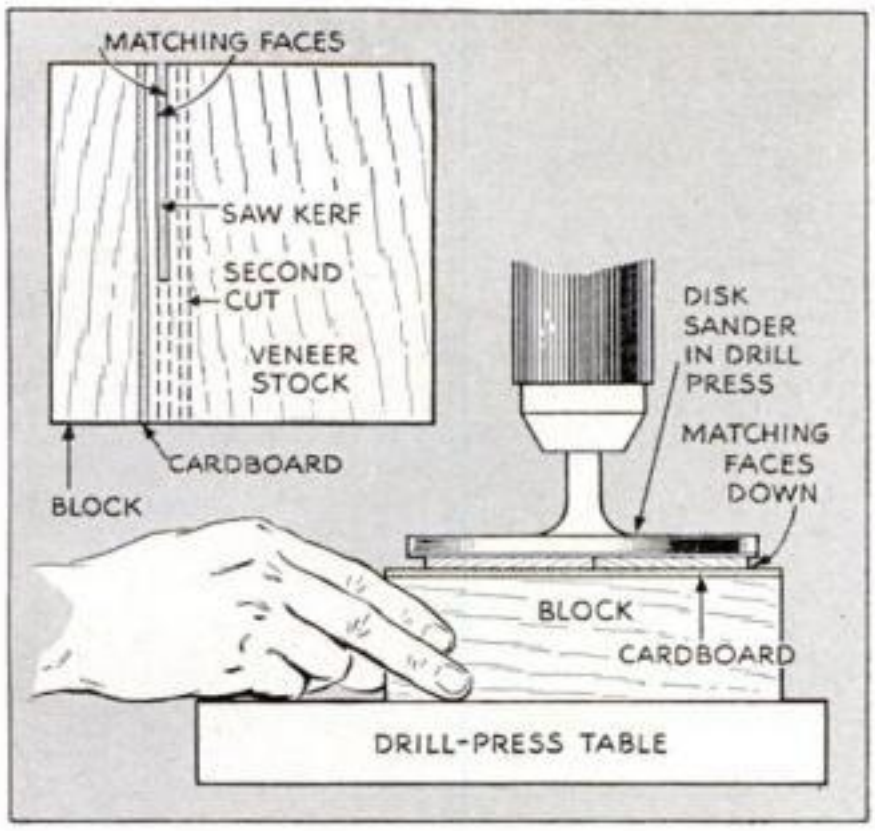
Connectors are tightened after boxes are in place

CONNECTING two outlet boxes with a single straight piece of conduit is difficult where the boxes face opposite sides of the wall. An easier way is to use a U-shaped piece that enters the sides of the boxes, which can be adjusted exactly flush in the finished wall before the conduit connectors are tightened. The same method also affords greater flexibility with BX cable.

Wet Gloves Aid Outdoor Cook

DON'T burn your fingers trying to retrieve a potato from the embers. Take a pair of canvas work gloves to your next picnic. Soaked in water, they protect almost as much as asbestos.—SIGMUND SAMETH.

Small Pieces of Matched Veneer Cut from Scrap Stock



SCRAPS of rare or even ordinary woods with especially pleasing grain can be utilized for inlays or matched veneer surfaces on small craftwork pieces such as cigarette or jewel boxes. To prepare the material, plane or sand one side of it smooth and flat. A disk sander will do this quickly. Then glue the surfaced side to a flat block with a piece of cardboard between. With as thin a blade on the circular saw or band saw as you can use, cut off the glued-up face, leaving about 1/16" of stock on the cardboard. The two fresh surfaces so obtained will vary only by the difference in grain through the waste. Sand them both, glue the original stock as before to another block, and cut off the second face.

After splitting off both pieces by inserting a knife blade into the cardboard, glue them, with the matching faces down, side by side on another block, again using cardboard in the joint. They can then be sanded to the desired thickness, which for most veneers is 1/28". On inlay work, if it is not necessary to match the grain, the material can be sanded flush after it has been glued in place.

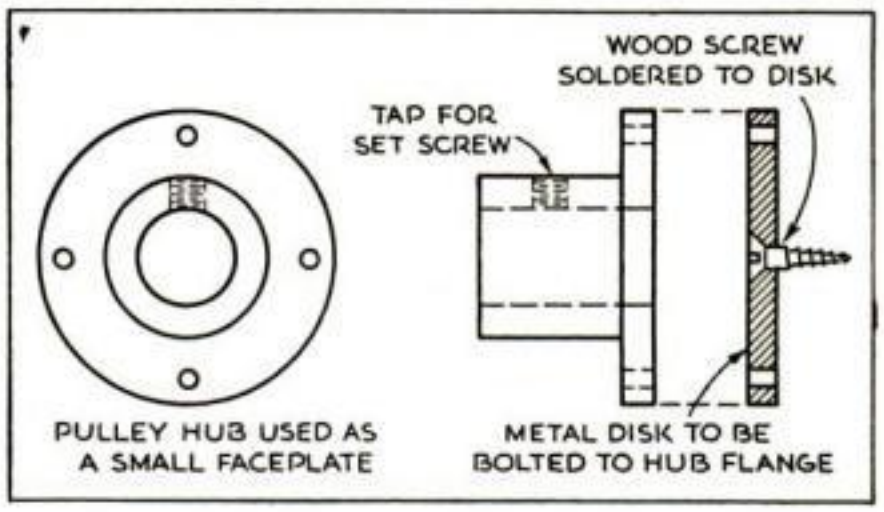
Successive matched sheets can be cut in this way from the same block of wood until it is used up. Glue each face to cardboard before sawing it off.—J. BRUMFIELD.

Rubber Tube Aids in Placing Steel Balls in a Bearing

THE always awkward task of replacing small steel balls in a ball bearing becomes a good deal easier if a piece of rubber tubing of suitable diameter is used to pick them up. Just press the end of the tubing gently on a ball. It will grip so that the ball can be lifted and put in place.—B. N.

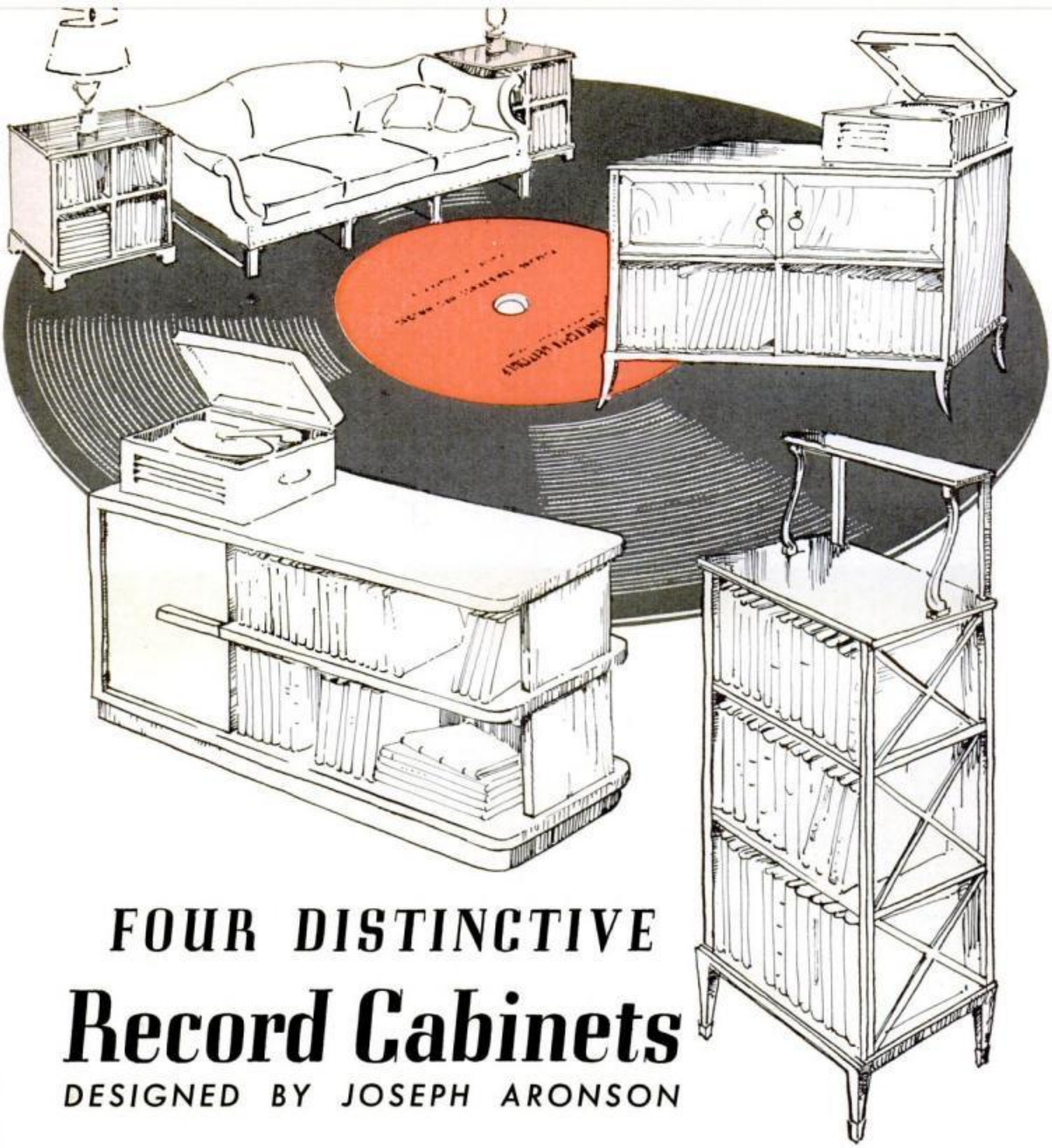
Solder Serves for Plating Screws

A SUBSTITUTE for plated screws and bolts may be made by first warming brass or iron ones, then dipping them into soldering acid, and finally immersing them in molten solder for a few seconds. Shake the excess solder off briskly.—N. E. HYKAS.



Junked Auto-Generator Parts Form Lathe Accessories

EXTRA faceplates, screw centers, drill pads, and other accessories for wood and metal-turning lathes are easily made from old automobile-generator pulley hubs. Those bored for a 5/8" shaft are a useful size. Drill or chisel off the rivets. Drill and tap the hub for a 5/16" set screw, and you have a small, precisely machined faceplate for mounting in the chuck on a 5/8" straight arbor. Machine a flat plate, solder a wood screw in the center, and bolt to the hub to make a wood-turning screw center. A tapered shank with a 1" long straight portion 5/8" in diameter converts the original faceplate into a tailstock drill pad. Thread the hub to fit the spindle or turn and thread an adapter with a threaded nose or a 5/8" arbor to fit the hub if you wish to use these accessories on a screw-cutting lathe.—A. J. MCCANN.



FOUR DISTINCTIVE
Record Cabinets
DESIGNED BY JOSEPH ARONSON

ALL too many commercially made record cabinets do not meet the home planner's needs, either because they do not afford enough storage space or because they fail to harmonize with other furnishings. Here the home craftsman has a real advantage, for distinctive, practical pieces of this kind are not difficult to make. Above are pictured several of ample capacity and sound design that can be constructed by anyone possessing average woodworking skill.

Well-proportioned cabinets flanking a sofa may support matched lamps to form an attractive group as shown at the upper left in the illustration. They should be about 32" high, 16" deep, and 26" wide. A very different type is the high cabinet with openwork sides, somewhat in the Regency style, at the lower right. The main part might be 46" high, 15" deep, and 20" wide, and the narrow shelf should stand 12" above the top. At the upper right is a long cabinet having an open lower shelf for albums and closed upper compartments for loose records. It is suggested that this be 33" high, with a 16" by 48" top.

The modern cabinet shown at the lower left may be placed either lengthwise of a wall or at right angles to it. It can be built from whatever material you prefer, but the dimensions given are based on the use of ¾" plywood. They may, of course, be modified at will, but the open shelves should be spaced

to accommodate standard record albums. In the closed compartment, and, for that matter, in that part of any cabinet where loose records are to be kept, wire racks or wooden partitions should be installed.

The door is set back ¾", so that the handle appears to be an extension of the shelf. The latter is carried through the closed portion, being cut back only at the front for the door. Note that the inside wall and the back of the closed compartment each consist of two pieces fitted above and below the shelf. A tray fastened to the inside of the door is convenient for holding brushes, needles, and other small articles.

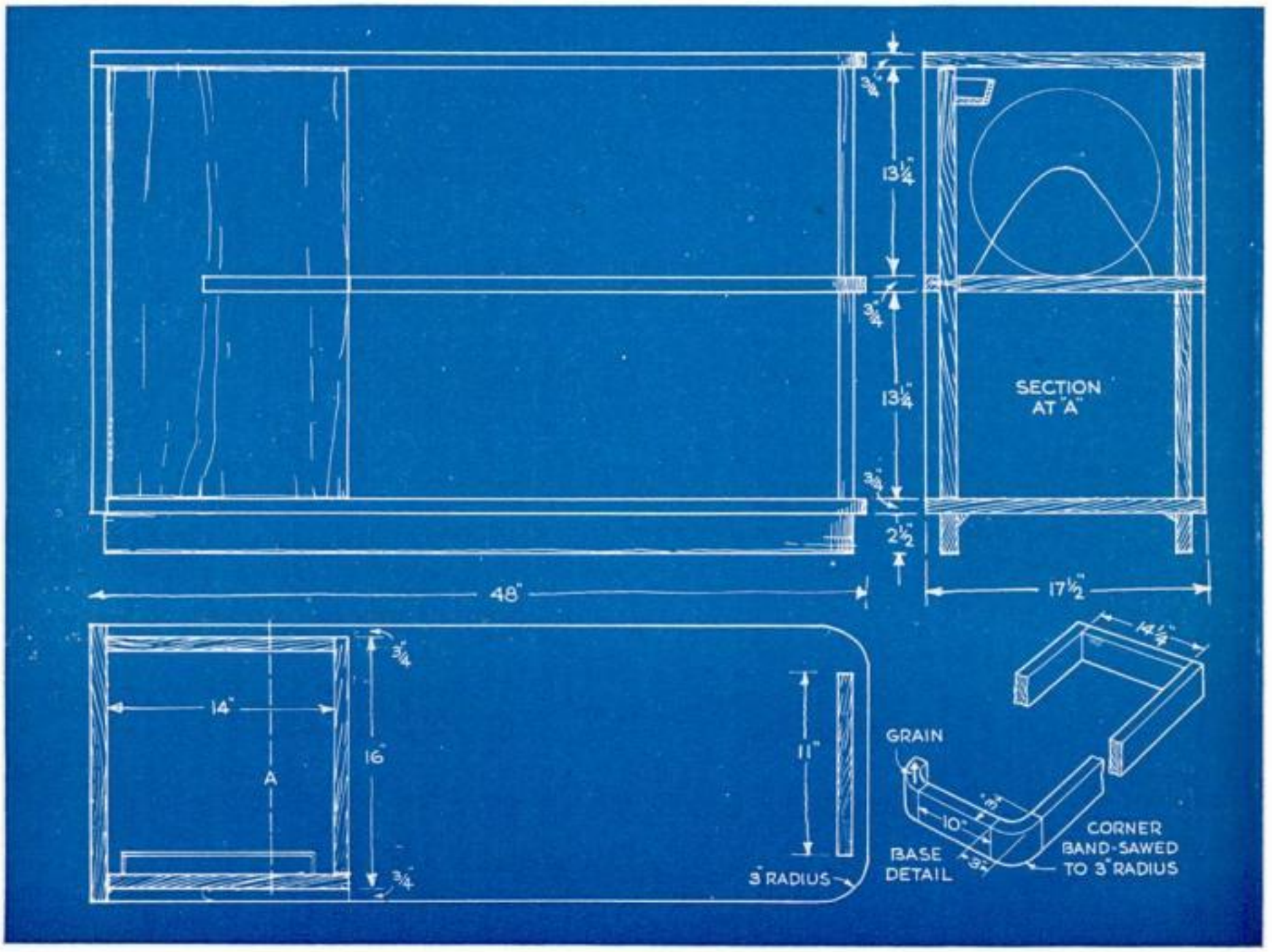
Doweled joints, securely glued, will insure sound construction. For game rooms or vacation homes, it might be permissible to fasten the parts with finishing nails and fill the nail holes.

LIST OF MATERIALS

MODERN RECORD CABINET

No. Pc.	Description	T.	W.	L.
1	Top (plywood)	¾	17½	48
1	Shelf "	¾	17½	47¼
1	Floor "	¾	17½	47¼
1	Endpiece "	¾	17½	28
2	Inner walls (plywood)	¾	13¼	15¼
2	Back panels "	¾	13¼	14
2	Shelf supports "	¾	11	13¼
1	Door (plywood)	¾	14¾	27¼
1	Handle	¾	¾	8
1	Base	⅞	2½	14¼
2	"	⅞	2½	43½
1	"	⅞	2½	10
2	Base corners (band-sawed)	1⅝	2½	4⅜
1	Accessory-tray floor	½	1¾	11
1	" " front	¼	1½	12
2	" " ends	½	1½	2½
2	Narrow butts			
1	Cupboard catch			

Note: All dimensions are given in inches and are finished sizes.



HW 11

Good Sport with

By
CHARLES and BERTRAM BROWNOLD

AMONG the weapons of primitive man, the throwing stick is one of the simplest to make and use, and it therefore has all the elements of an entertaining outdoor target game, provided space is available and sufficient precautions can be taken against accidental injury to onlookers.

Prehistoric man is believed to have used the throwing stick, and it has been found among the natives of the upper Amazon regions of South America, in Australia, in Mexico, and among our own Southwestern Indians. The model illustrated here, however, is based upon an Eskimo design, still popular in the Arctic. The throwing stick has remained in use among the Eskimos for centuries because much of their hunting is done in frail kayaks. Aided by the stick, an Eskimo can hurl a spear with great force from a sitting position without endangering his equilibrium even when handicapped by rough water, floating ice, high winds, and extreme cold. A float, usually an inflated bladder, is attached to the spear by a light line. The float guides the hunter to the impaled game and also hinders its escape.

As modified for use in a target game, the throwing stick is simply a ¾" thick piece of wood about 19" long and 3" in width at its widest point, just beyond the handle. Down its center is a groove for a light spear. The throw, starting with the stick in a horizontal position, is overhand and with a wrist snap. Force is applied to the butt end of the spear, which rests against a stop

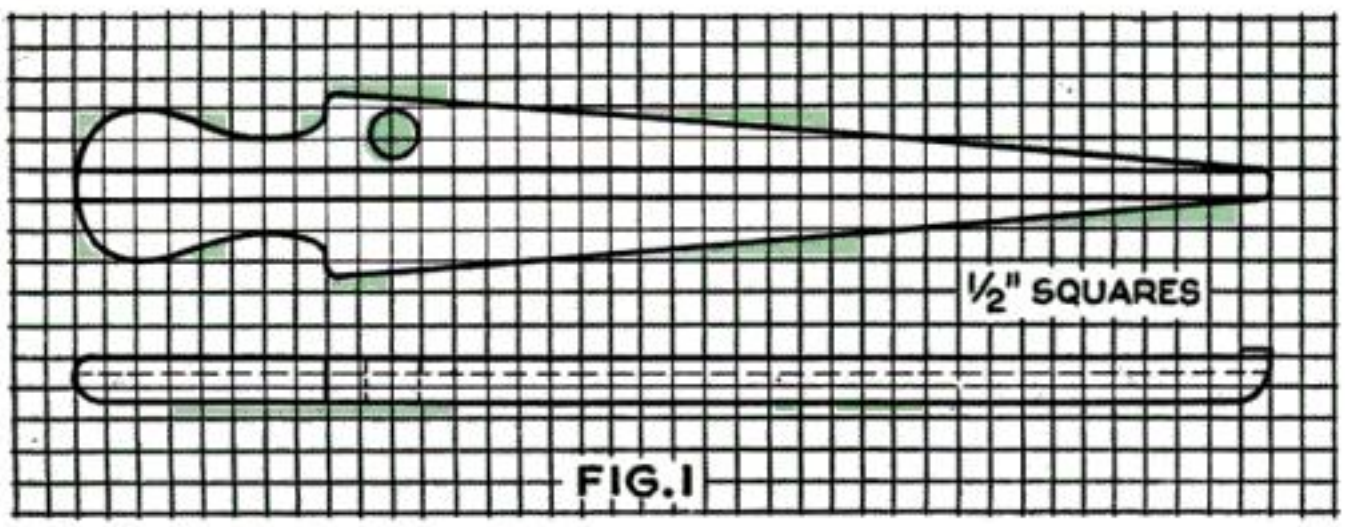
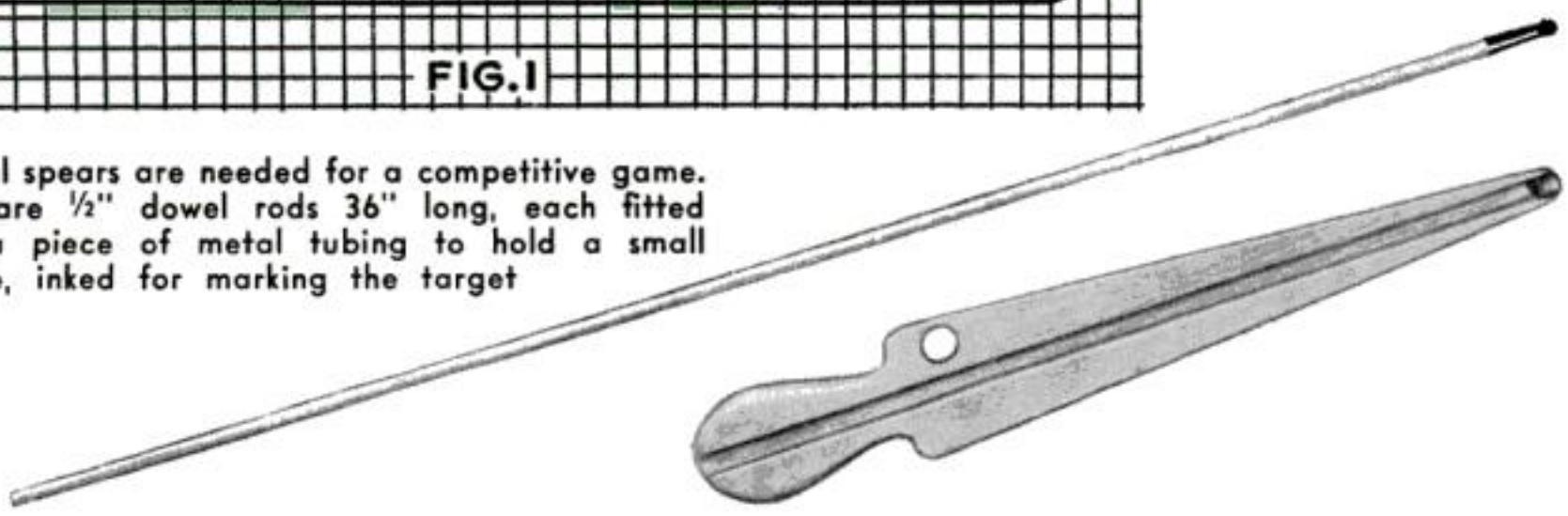


FIG. 1

Cut the groove first, either half-round or square, to hold the light spear. Shape the handle and bore the finger hole next, as in the pattern; then glue in the block. Taper after the glue has set



Several spears are needed for a competitive game. They are ½" dowel rods 36" long, each fitted with a piece of metal tubing to hold a small sponge, inked for marking the target

a Throwing Stick

at the end of the groove—enough force to carry the spear smartly to a target 30 yards away. The stick acts as an extension, or third section, of the arm, making it in a sense half again as long as the natural arm. This permits exertion of a forward thrust on the spear for a longer period, and at the same time the tip of the stick moves through its arc more rapidly than does the hand.

To make a stick, cut a half-round or square groove ½" wide and ¼" deep down the center of the wood stock, using a bench saw if one is available. Then shape the handle, bore a hole for the forefinger as shown in the drawing, and glue a small hardwood block tightly into the far end of the groove. After the glue has set, taper the stick to shape.

Spears are ½" dowel rods 36" long. On one end of each is fitted a piece of metal tubing into which is thrust a small inked sponge for marking the target. These targets can be made 24" in diameter from any cheap paper, or else can be purchased.

A few simple rules will help make competition exciting. Draw lines or peg down tape at 20 and 30 yards from the target, and have each player throw three spears from each of these lines for a single round. Stepping over the line is a foul or foot fault, no score being allowed for a foul throw. Score the better mark for a spear that strikes the dividing line between two rings on the target. After six rounds, total the scores to determine the winner. A different colored ink for each player will help in this by automatically identifying all hits.

Be sure that all players and spectators stand behind the throwing line and that no throws are made while spears are being retrieved. The spears are thrown with considerable force, and the metal tips could cause severe injury.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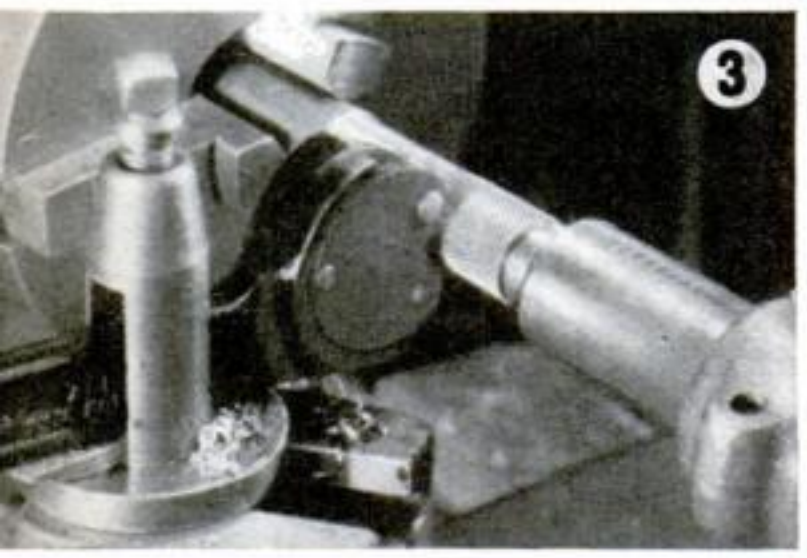
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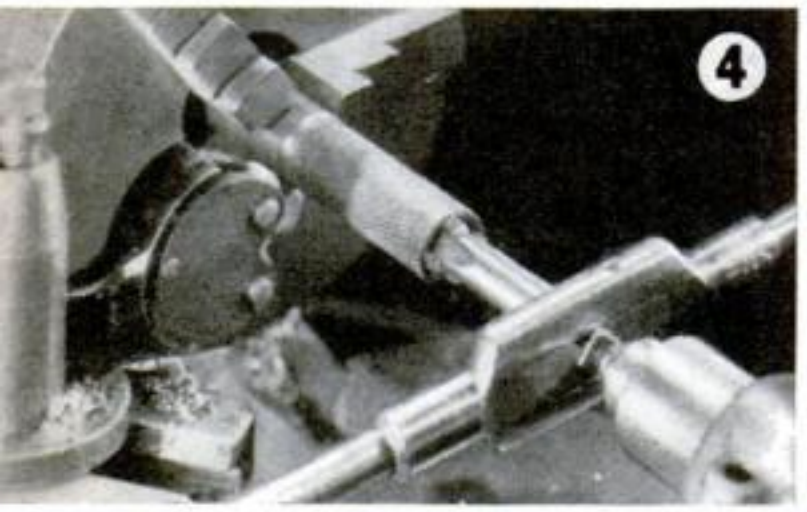
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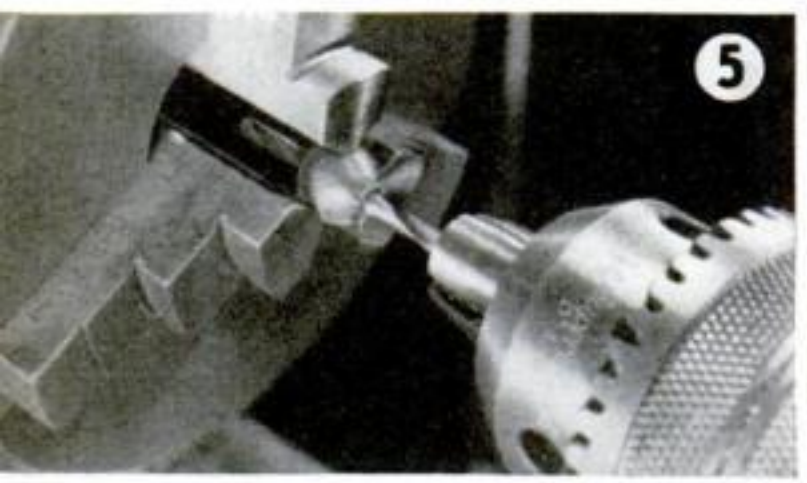
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Dimensions for the wiggler indicator are given in the drawings at right. Bevel the edge of the needle hole in the cap. Hollow out one end of the follower plug to fit the needle ball

Wiggler Indicator Tests Centering of Work Mounted in Lathe

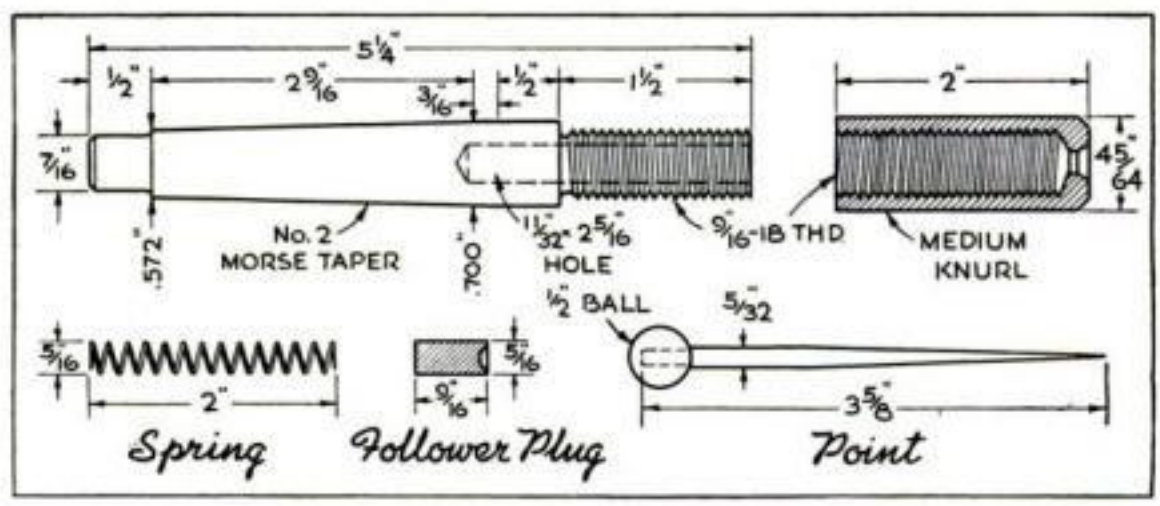
THIS type of indicator (Fig. 1) is held in the tailstock of a lathe for testing work in a chuck or on a faceplate. With the wiggler point inserted in a center-punch mark, the work is rotated and adjusted until the wiggler point runs true.

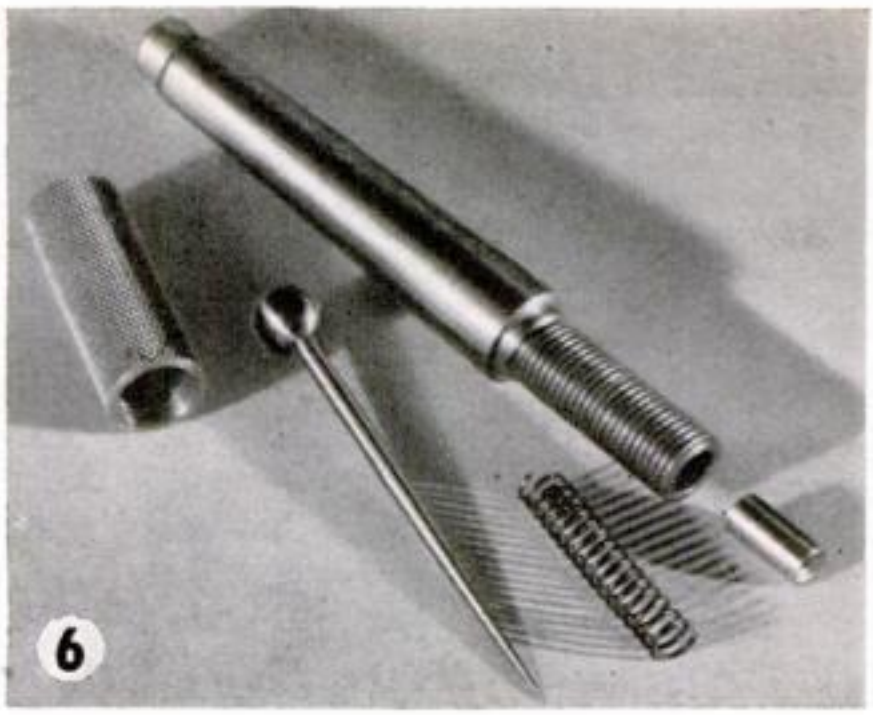
The steel shank is taper-turned from a ¾" steel bar to fit the tailstock spindle, the outer end being drilled for a spiral spring and a follower plug, which exert pressure against a ball on the end of the needle. This pressure can be varied by turning the adjusting cap. The shank is taper-turned, filed smooth, polished, cut off, and then slipped into the headstock, as in Fig. 2, to cut the threads for the cap and to drill the 11/32" hole for the spring and follower.

The cap also can be made from ¾" bar. It is centerdrilled for mounting in a chuck and on the tailstock center. Turn it 3/64" smaller in diameter to remove the outer shell of the stock, and knurl it with a medium knurl (Fig. 3). While it is still chucked, a 33/64" hole is drilled in it 1⅞" deep. This is tapped for 9/16"-18 threads, with the tap supported on the tailstock center to insure alignment, as in Fig. 4.

Following this, the cap is cut off, reversed, and lightly clamped in the chuck, with cardboard between it and the jaws, so that the hole for the needle can be drilled and its edge beveled as shown in the drawings. Make the needle from drill rod, filing the point to shape while the lathe runs at high speed. Shoulder down the other end for a drive fit into the ball.

This is an ordinary ½" ball bearing, which is slipped between the coils of a spring and suspended





over a gas flame until bright red. Lower the flame gradually, letting the ball cool slowly. This anneals it for drilling. Grip it in a three-jaw chuck as in Fig. 5. Start the hole with a small center drill and finish with a ⅛" drill, but do not run this all the way through. Drive the needle tightly into the ball.

Wind the spring from No. 20 spring-steel wire around a ¼" rod. Feed the wire between two wood blocks clamped on the tool post, and use the screw feed of the lathe to produce an open winding. Turn the follower plug. This completes the parts, which are all shown in Fig. 6. Slip the spring into the shank, then the plug. Insert the needle through the cap with the ball inside, and screw the cap upon the shank.

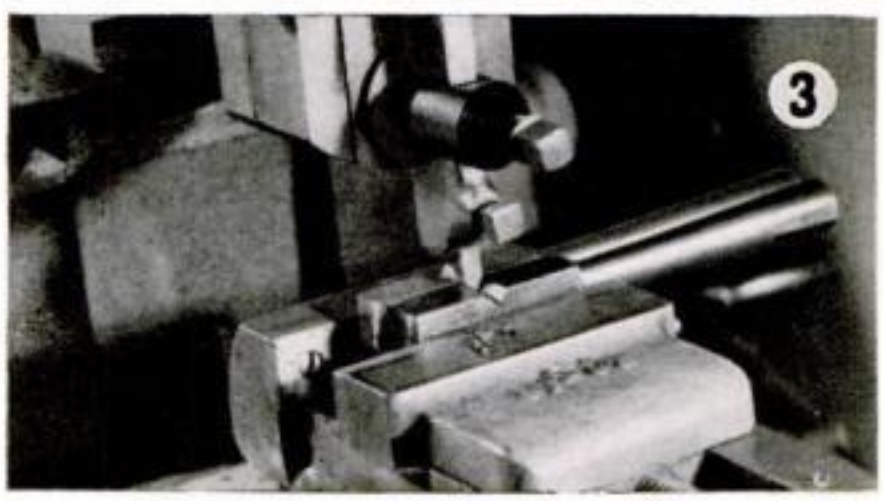
Making Heavy-Duty Tap Wrench Gives Practice in Taper Turning

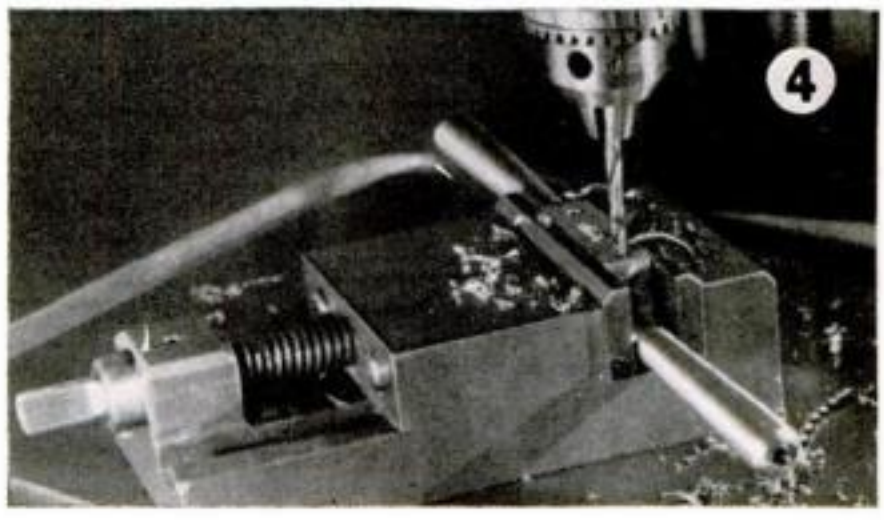
THE tap wrench shown in Fig. 1 is compact and very strong. It can be constructed in various sizes; as dimensioned, it will take taps from ¼" to ⅝". The operations involved in making it are straightforward, yet varied enough to be interesting.

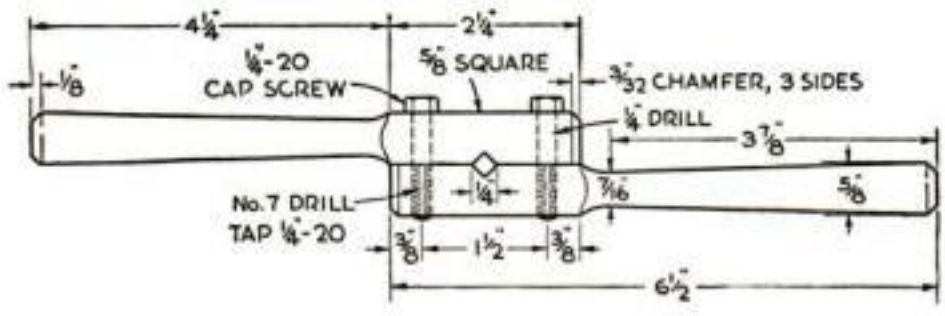
Use ⅝" square cold-rolled steel for the two handles. Centerdrill one end of each piece for tailstock support, chucking the other in a four-jaw chuck as in Fig. 2. Turn to the slight taper indicated in the drawings, using the taper attachment. When the lathe work is done, polish the turned portion with emery cloth.

The V-shaped notches to grip the taps can be cut in the shaper while both handles are clamped together in the vise, as shown in Fig. 3. If no shaper is available, the notches can be filed by hand. Lay out the screw holes carefully and drill them through both pieces at the same time to insure alignment (Fig. 4). Use a No. 7 drill.

The holes in one handle are tapped ¼"-20; those in the other are opened out with a ¼" drill to clear the clamping screws. Three sides of the square ends of the handles are chamfered as shown in the drawings. Draw-file the flat areas bright.





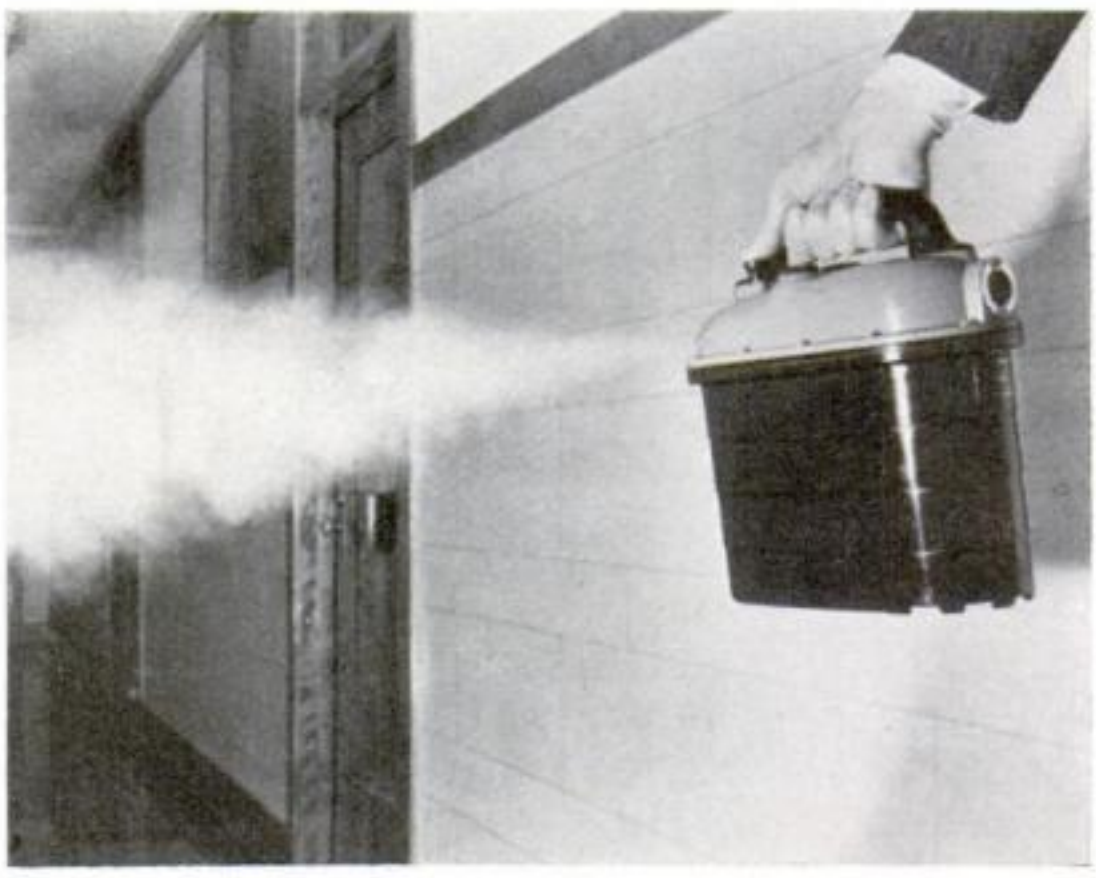


IDEAS for HOME OWNERS

AWNING PAINT that is sun resistant and water repellent has been developed to meet a need, now that householders are thinking more and more in terms of making old things do instead of buying new. It can be brushed or sprayed on either faded duck or canvas, will not stiffen the fabric or crack, and will retard mildew and rot. Striped awnings can be painted in a solid color to match their darker stripe, or restriped with the aid of masking tape to insure straight lines. The paint is effective also for freshening up beach umbrellas, *cabañas,* tents, sails, boat covers, and the like. Nine shades, including white and black, are available.

THIS SWIVEL ELECTRIC PLUG will swing freely in any direction or turn completely around without danger of breaking wires in the cord and the resultant fuse blowing and annoying interruption in the day's ironing. The wires are attached to the swivel arm itself, not to the plug, thus eliminating cord torsion, and the arm makes contact with the terminals through a patented arrangement. The plug will be found useful on small appliances other than irons.

INSECTICIDE SPRAYED under steam pressure from the electrically heated device shown below will penetrate cracks and crevices in walls and floors, reaching insect pests at their breeding point. Water in the heat chamber is generated into superheated steam, which forces liquid insecticide out under such great pressure that its fine spray will carry as far as 15′. A thumb control near the handle, located so that the sprayer can be held and operated with one hand, regulates the force with which the insecticide is expelled from the jet, making it possible to cut the distance the vapor travels to 12″ or less and adapting the unit to use in gardens where too heavy a discharge might prove harmful to growing plants.

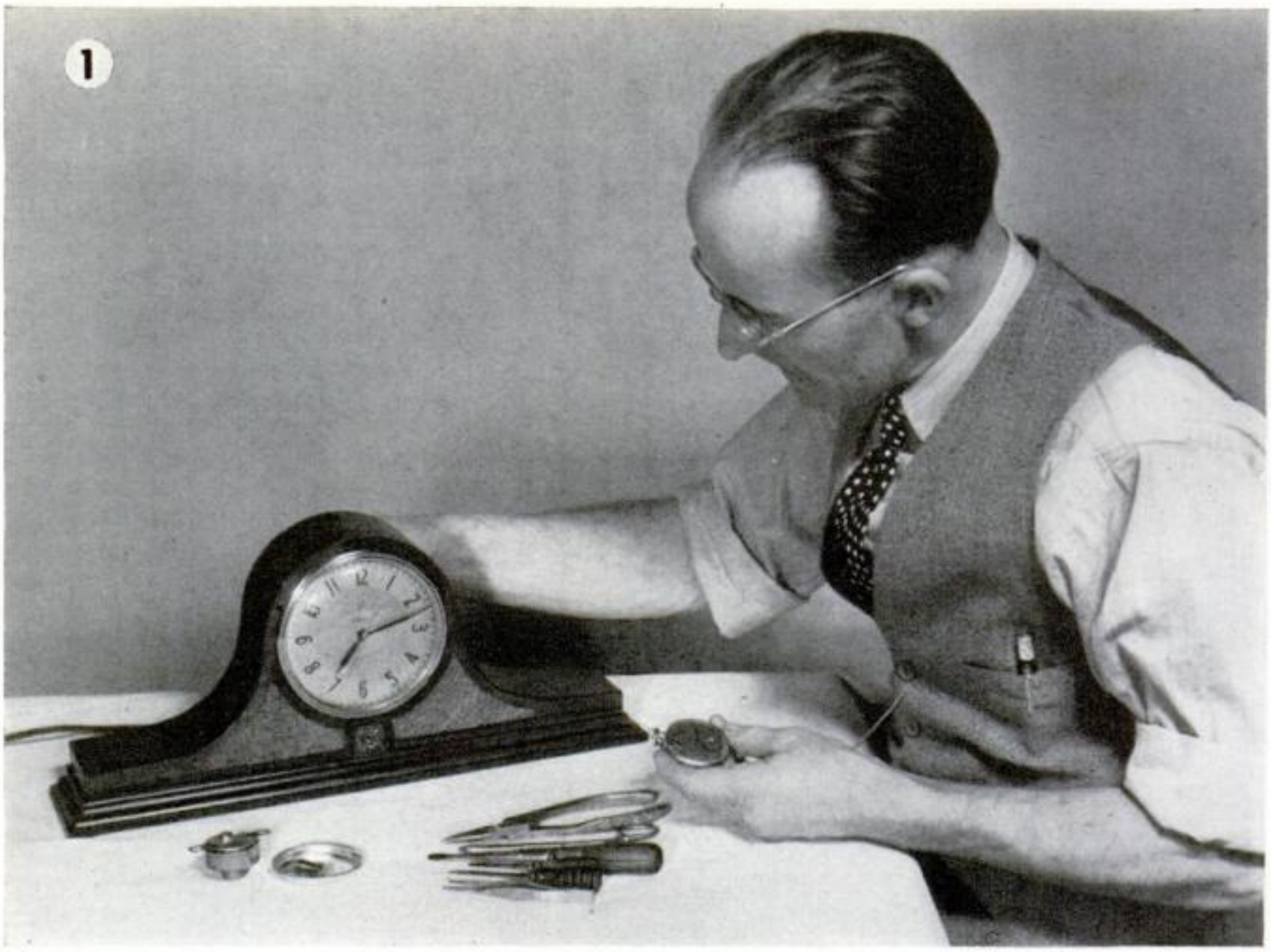


PARALYZING INSECTS' LEGS rather than their wings is the feature offered in a new insecticide, which works on the theory that even flying insects are rendered harmless when they cannot crawl. The product is said to cause permanent paralysis of those pests that escape a dose strong enough to kill outright. It comes in an ingenious container, designed to be converted quickly into the bowl for a spray gun. On the side of the can is a button insert with a soft seal that can be pierced by the intake tube of the sprayer. Flanges on the gun fit into slots to hold the can securely.

DOOR CHAIN AND BURGLAR ALARM are combined in the safety lock at the right, which will give out a loud and continuous ring at any time pressure is exerted on the trigger to which the finger in the photograph points. Action of the bell is entirely mechanical, and ringing will keep on for several minutes or until pressure is released. To be set, the bell is rotated until a strong spring which operates the clapper is wound tight. Then the free end of the chain is inserted in the slot. Any attempt to open the door will cause the chain to slide toward the trigger.

MASONRY AND PAINTED SURFACES ARE SEALED against moisture and excess wear by the application of a flexible film originally developed by the Chinese to preserve the color of their temples and pagodas. The base of the preparation as now manufactured in this country is tung oil, to which have been added specially cooked varnishes, making a flexible, tough, and long-lasting coat which penetrates the surface in addition to forming a protecting film. The liquid is transparent and almost colorless, and will not change the appearance of bricks, masonry, or paint. It may be used on either indoor or outdoor surfaces for such purposes as protecting iron garden ornaments and furniture, brass fittings on boats, outdoor metal fixtures, cellar walls, and painted woodwork.

Brushed on as paint, this new film forms a protecting, flexible seal. Note its action at left when a pencil is pressed against it



Servicing Electric Clocks

By HAROLD P. STRAND

MODERN electric clocks of the better grade are such dependable timepieces and require so little attention that their trouble-free operation is taken for granted. Occasionally, however, one may refuse to run, stop inexplicably when the line voltage drops too low, become noisy, or otherwise misbehave. There is no reason why the home mechanic cannot make the repairs necessary in such a case, provided he is at all skillful in handling delicate work.

The accompanying photographs show step by step what was done in overhauling a typical mantel clock (Fig. 1), which was keeping time but had developed an annoying grinding noise. A sheet of white cloth was spread on a cleared table top to prevent scratching of any parts and to make it possible to find dropped screws and other tiny articles more readily. The knob that sets the hands was first removed by holding the shaft with thin-nosed pliers and turning the knob to the *right* with another pair.

After this, the machine screws that held the movement in the case were removed, and the entire movement was taken out from the front of the case as shown in Fig. 2. Enough cord was pulled through to permit manipulating the unit freely.

The next step was to test the coil for an open circuit by holding a small screw driver against the laminated field core while the cord was connected to an outlet. Although not vital in this case, the test would be an important one in repairing a clock that did not run. If a moderately strong pull is felt, the coil is probably in good condition; if no pull at all can be felt, there is either a break in the cord, a loose connection at the plug, or a break in the coil winding. Check the plug first, then feel the wire along its entire length. If it is badly kinked or suspiciously weak at one spot, unsolder it at the coil and attach a new cord. In case the fault is in the coil itself, a new one can be obtained from the manufacturers of the clock or the local service agency.

Should the pull of the magnet be weak or the coil heat up excessively, there are probably some short-circuited turns. This is not

a common complaint, and cannot be verified except by using a resistance meter to compare the suspected coil with one known to be good. A partially short-circuited coil must, of course, be replaced.

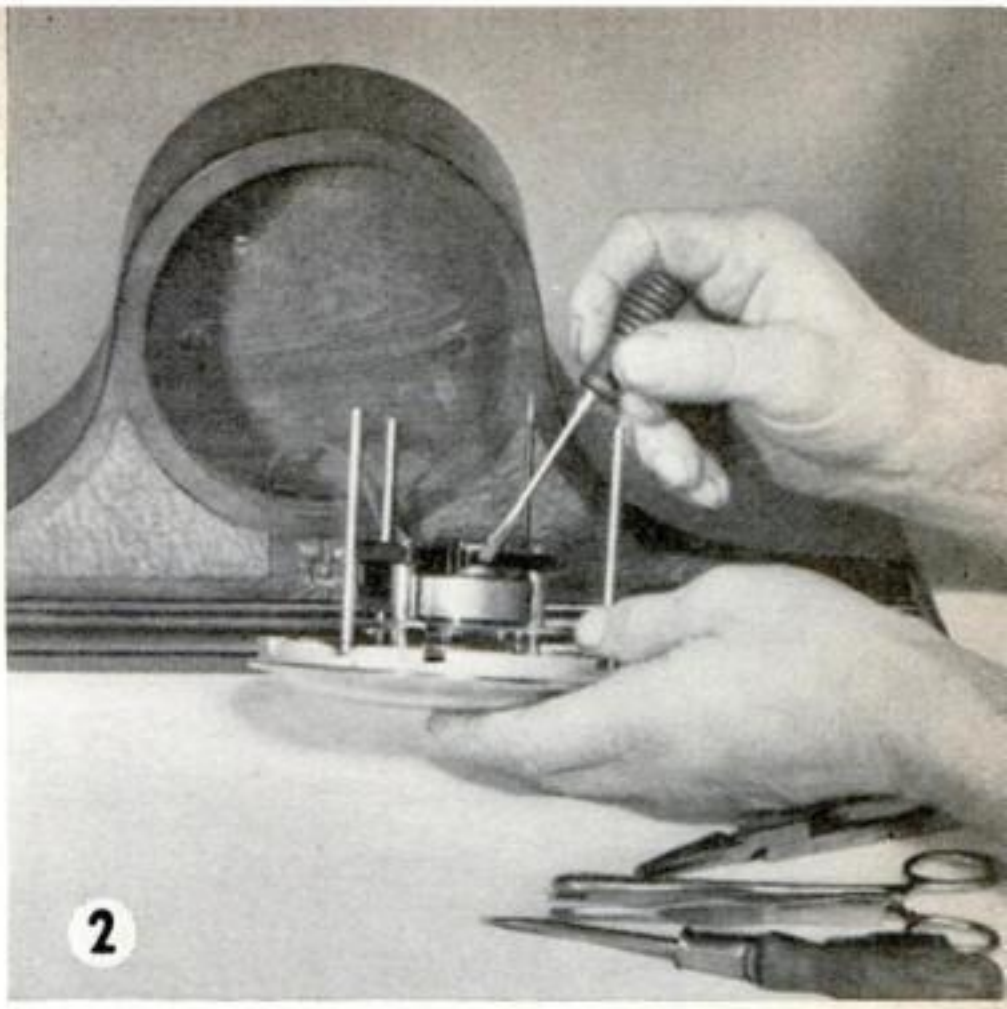
With the plug again disconnected, the movement shown here was thoroughly dusted with a small camel's-hair brush, and a careful inspection was made for particles of grit or dirt. After this, high-grade clock oil was applied very sparingly with a piece of thin wire to each bearing and other parts subject to friction (Fig. 3).

The cord was again plugged in, and the noise, continuing, seemed to come from the rotor unit. This was next removed by taking out the two machine screws that held the field assembly unit to the mounting plate, lifting off this part, turning it over, and pressing the rotor unit out from between the field poles as shown in Fig. 4.

In this clock, the sealed unit, shown with the field magnet in Fig. 5, contains the rotor and a train of tiny gears actuating a pinion on top of the case. These units are filled with a special lubricant at the factory and should not be tampered with. If one is noisy, the parts have become worn or the lubricant has broken down through oxidation. A new unit is inexpensive and can be obtained from the factory or local dealer.

A new unit was needed for the clock in hand, and installation was simple. The unit was taken in the fingers as shown in Fig. 6 and placed on the plate so the pinion fitted in the hole and meshed with the gear in the movement.

The field magnet was placed over the rotor unit and pressed gently down into position (Fig. 7), care being taken to see that the hand-setting shaft went into the hole provided for it in the field and the long machine screw that operates the current-interruption signal fitted into its hole in the mounting plate. It may be necessary to shift the rotor unit slightly to make all the parts line up properly. The new spacing sleeves were slipped between the field core and the mounting plate so that the spring arms on these would bear down on the rotor



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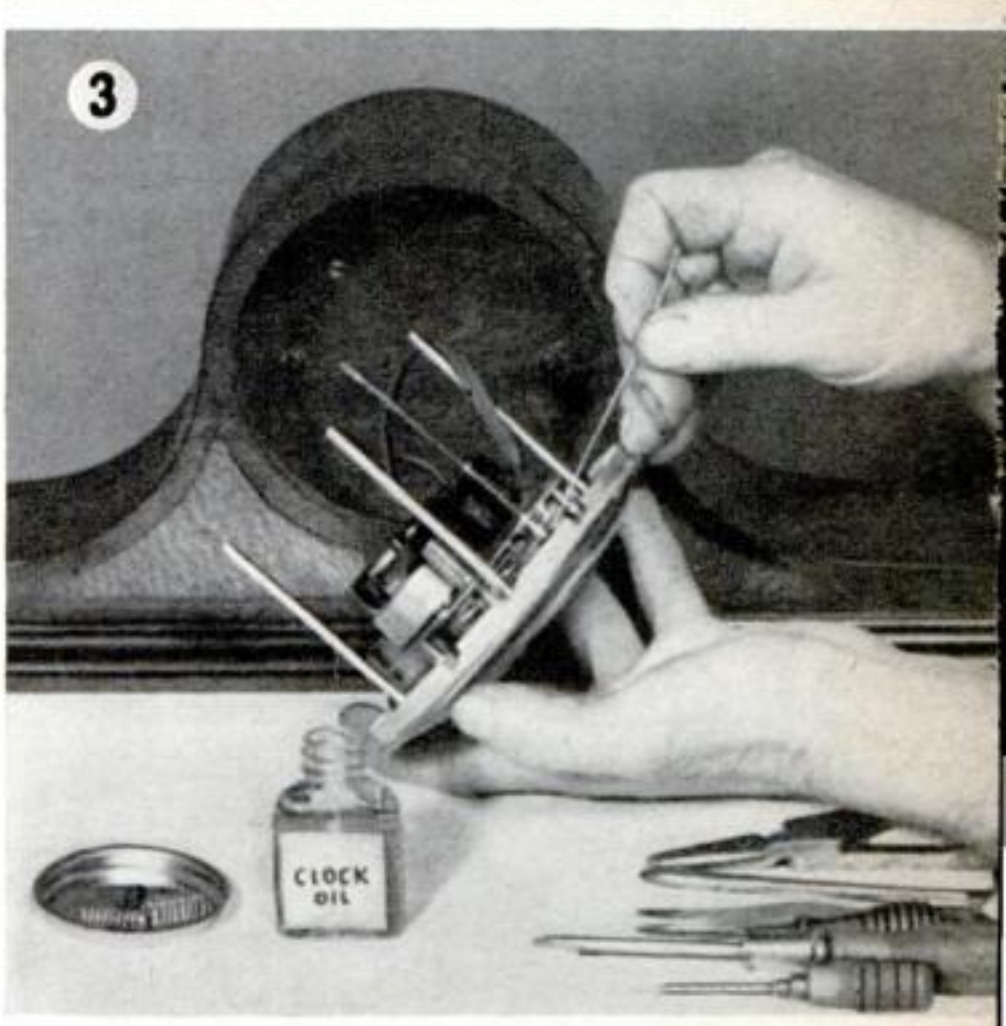

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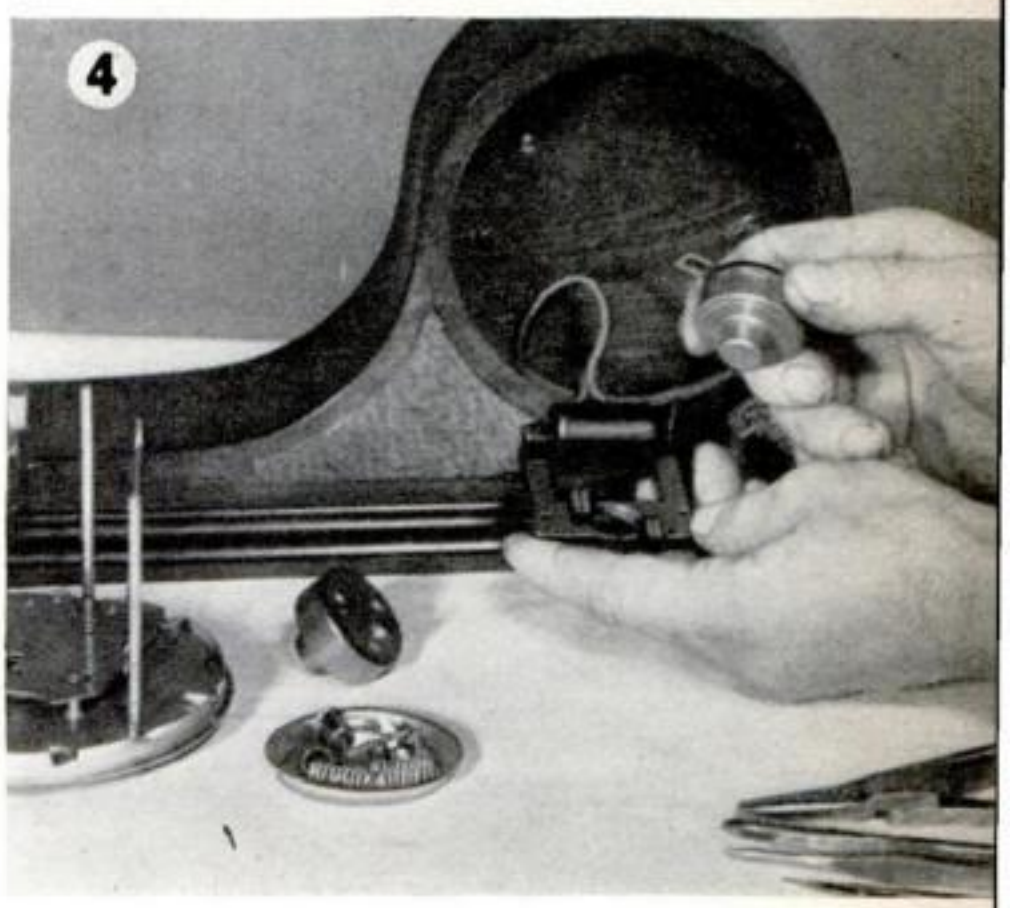

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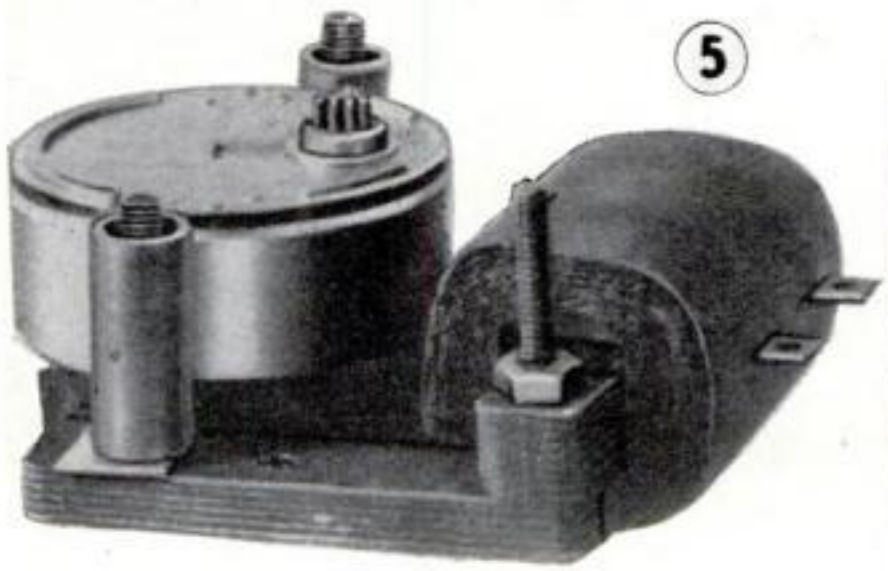

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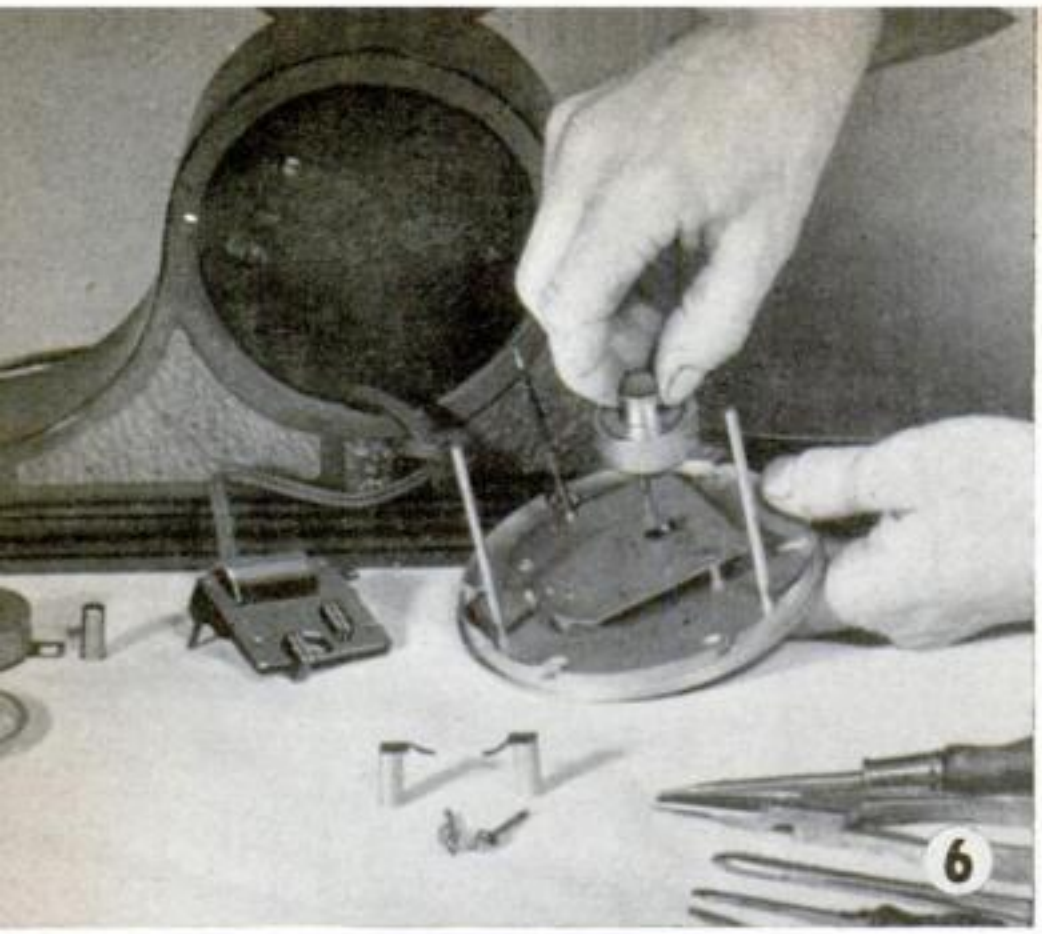
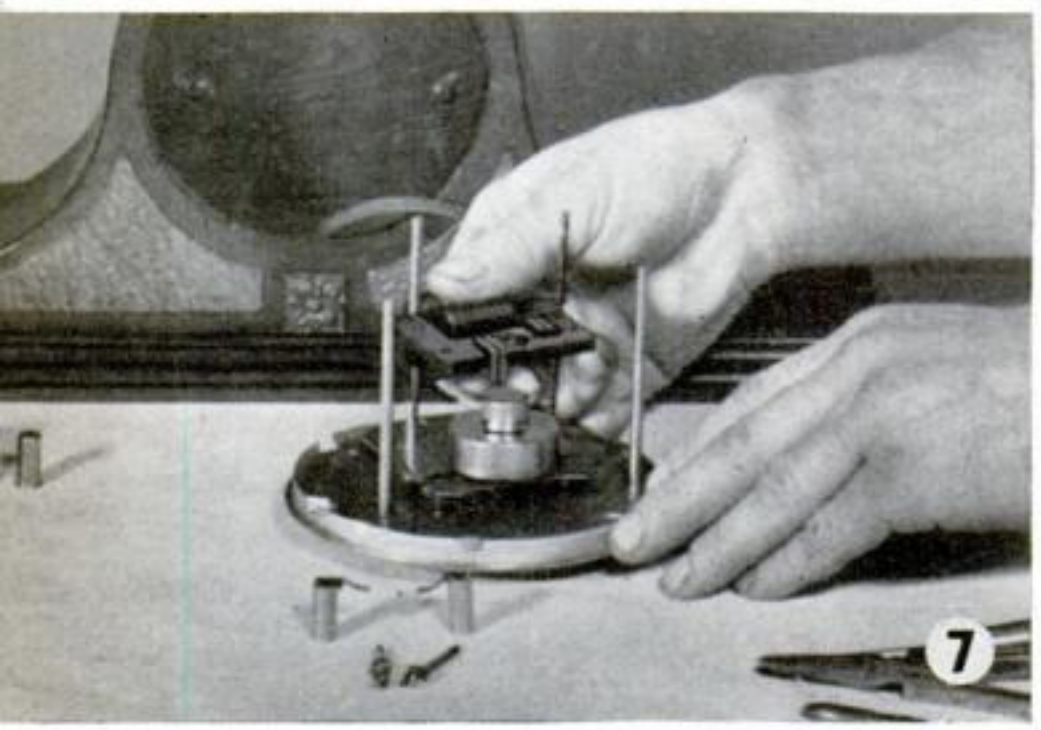




unit. This new unit and the two sleeves were somewhat different from the old parts, which are shown at the left in Figs. 6 and 7.

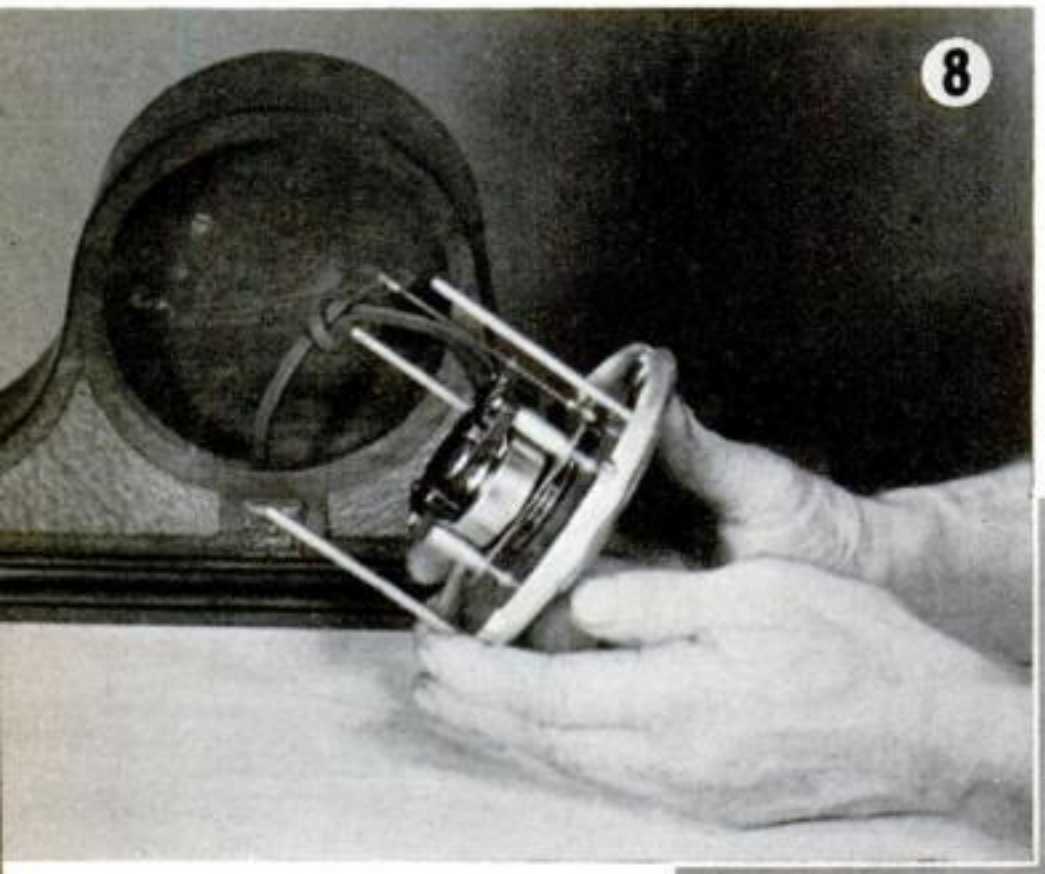
The mounting screws were next replaced. They pass through the sleeves, and should be screwed reasonably tight. The cord was then plugged in and the action of the mechanism checked (Fig. 8).

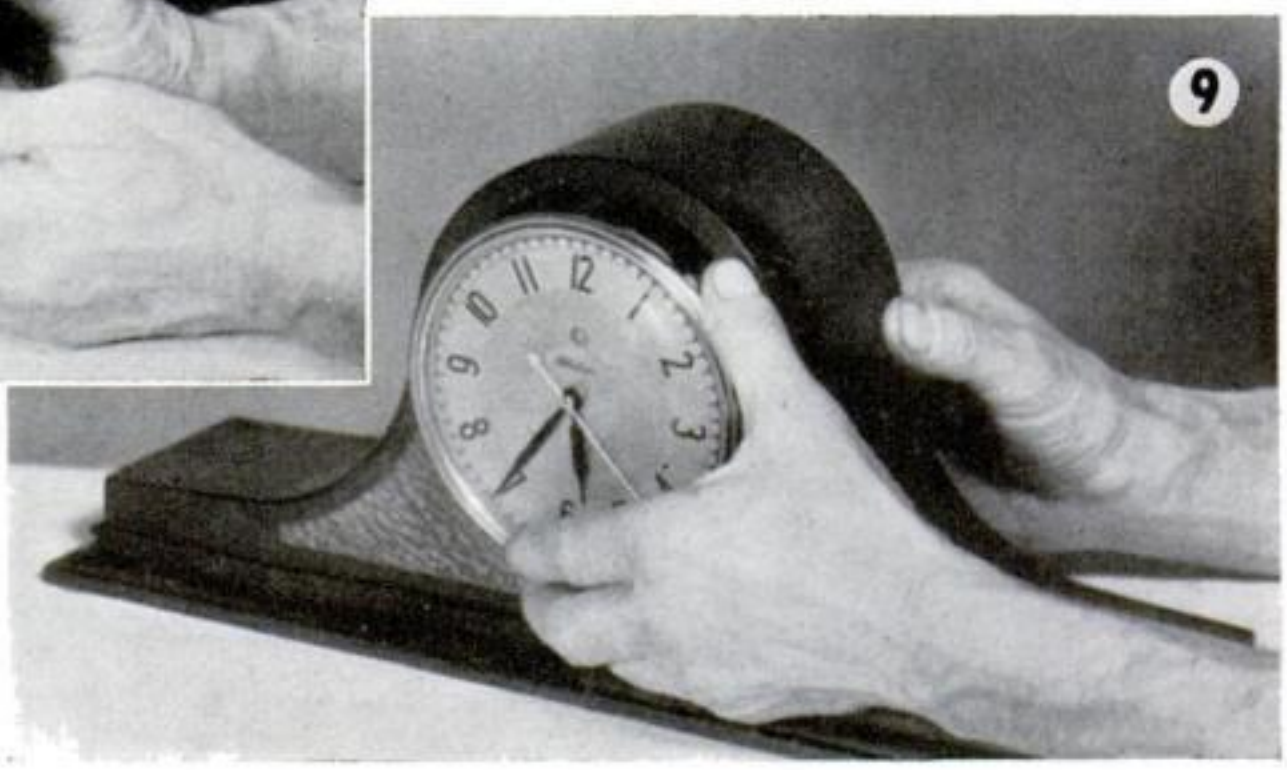
Replacing the movement in its case is a reverse of the steps first outlined. The slack cord was pulled back to the knot and the movement inserted so that the mounting rods and time-setting shaft would go through the proper holes in the back. The recessed washers and mounting springs were put in place over the ends of the three mounting rods and checked, and the screws then replaced (Fig. 9). The time-setting knob was replaced by turning it to the *left*. The clock was finally set, as shown in Fig. 1, and put back into service.

Several makes of clocks use sealed rotor units, and all can be repaired in the same general way. However, those which have an open laminated steel disk for a rotor and must be started by hand are another matter. When they become noisy or won't run, pinion bearings or other parts may be worn, and except for cleaning and oiling little can be done. If the case is valuable, a new movement might be installed.

One cause of a clock's running slow or stopping could be failure of the hands to clear each other or the rubbing of a hand against the dial or glass front. A clock that is being serviced should be checked for this.

The accuracy of synchronous clocks depends in the main upon the control of current frequency at the powerhouse, a frequency which large companies maintain at 60 cycles a second, checking the speed of their alternators constantly. A master clock was developed for the purpose by Henry E. Warren. It is actuated by an accurate pendulum movement timed daily by radio signals from the U. S. Naval Observatory.





Question Bee

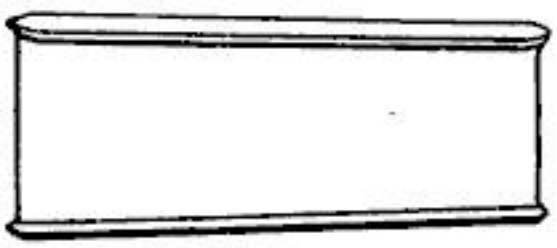
CAN YOU IDENTIFY THESE NAILS? The ten shown in the drawings below are frequently used by craftsmen. Establishing their identity should give little trouble to the average woodworker. They are a finishing nail, flathead barbed car nail, steel-cut flooring nail, flooring brad, roofing nail, oval-head chisel-point spike, slating nail, gimp tack, clamp nail, and clout nail, but they are not, of course, shown in this order. Try to identify them, write which you think each is in the numbered space provided, then check your results with the correct answers, given upside down at the bottom of the page

1 _ _ _ _ _

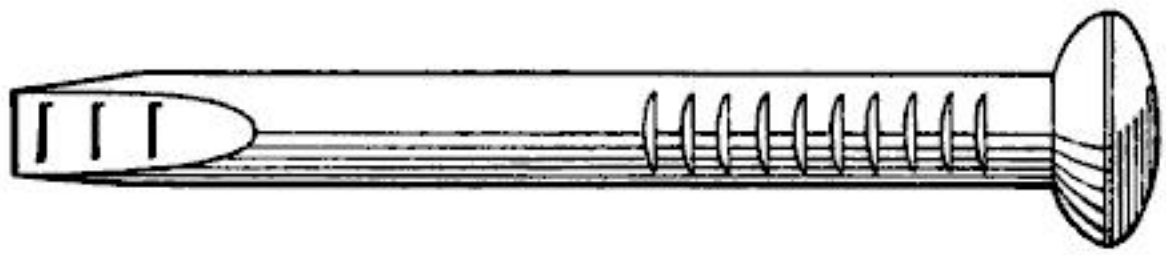
2 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

3 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

4 _ _ _ _ _ _ _

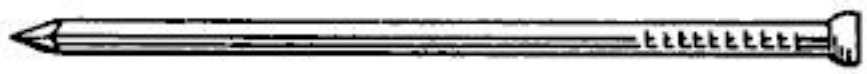


5 _ _ _ _ _ _ _



6 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

7 _ _ _ _ _ _ _ _ _ _ _ _ _



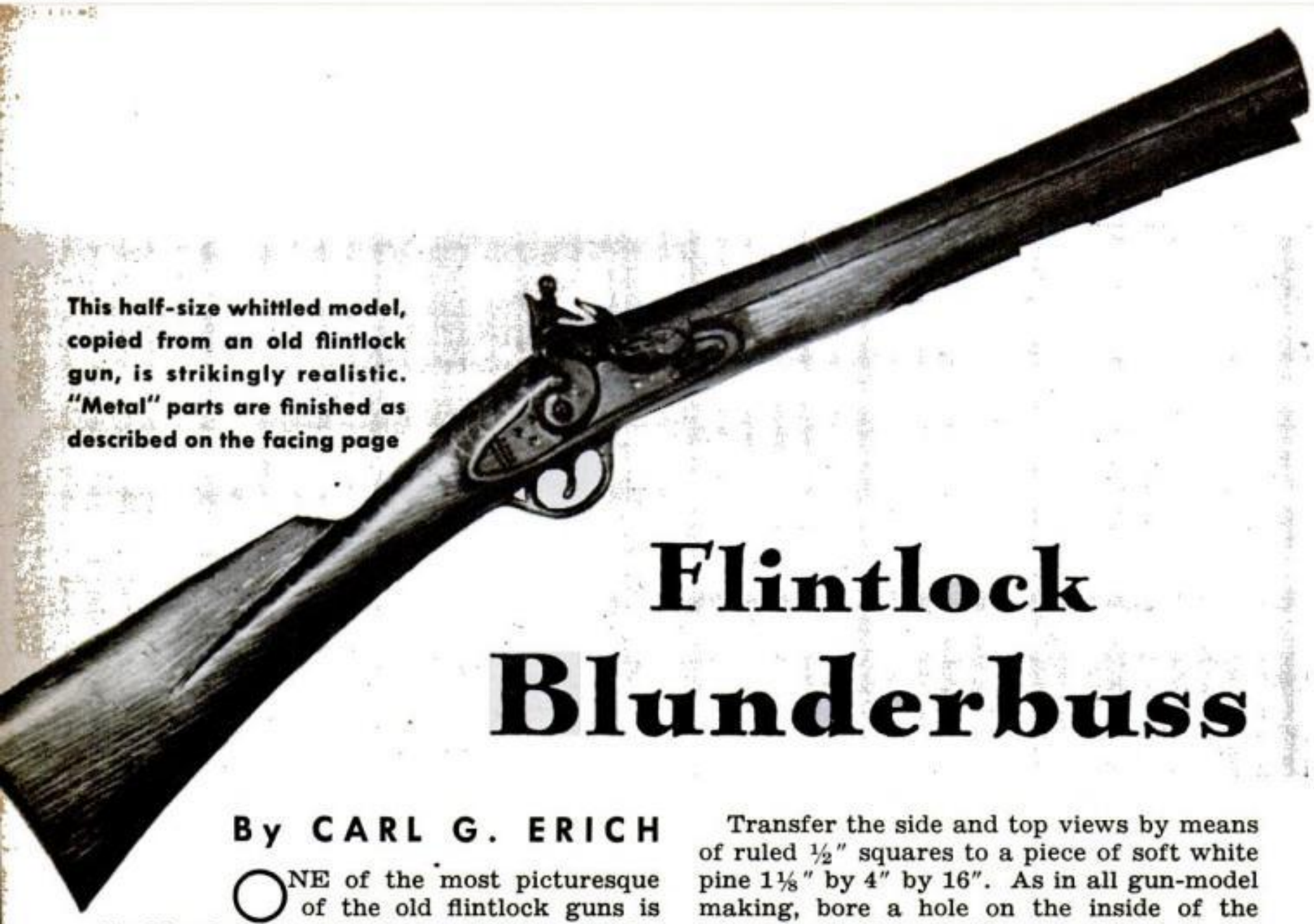
8 _ _ _ _ _ _ _ _ _ _ _ _ _

9 _ _ _ _ _ _ _ _ _

10 _ _ _ _ _ _ _ _ _ _ _ _

ANSWERS

1 Roofing nail
2 Flooring brad
3 Flathead barbed car nail
4 Slating nail
5 Clamp nail
6 Oval-head chisel-point spike
7 Steel-cut flooring nail
8 Finishing nail
9 Clout nail
10 Gimp tack



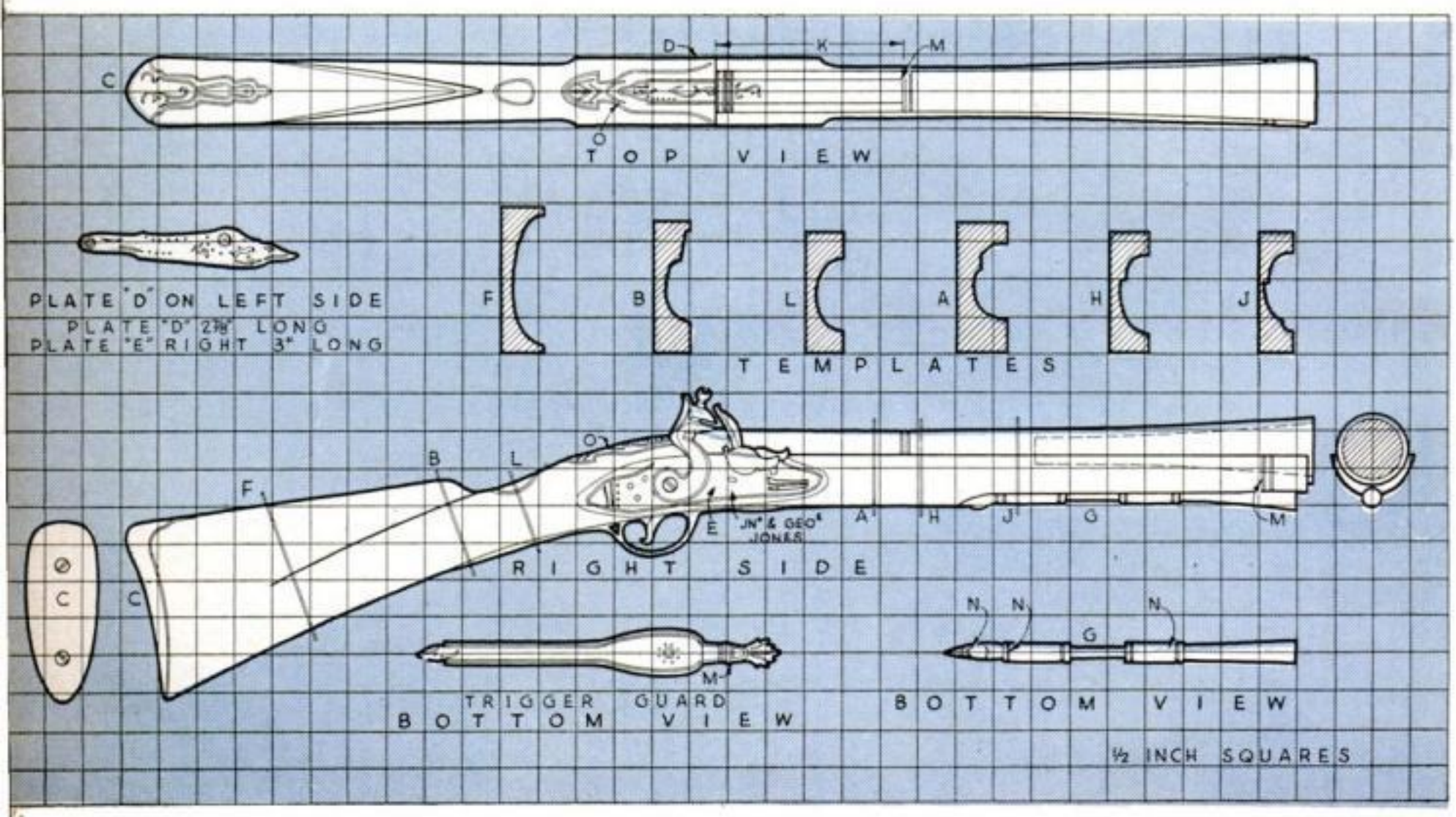
This half-size whittled model, copied from an old flintlock gun, is strikingly realistic. "Metal" parts are finished as described on the facing page

Flintlock Blunderbuss

By CARL G. ERICH

ONE of the most picturesque of the old flintlock guns is the blunderbuss, which was often carried by coach guards for protection against highwaymen. Its effective range was very short, for the charge of balls or slugs spread rapidly from the flaring muzzle. The prototype of our half-size model is a gun made by the firm of Jno. and Geo. Jones, of London, in the period between 1790 and 1810.

Transfer the side and top views by means of ruled ½" squares to a piece of soft white pine 1⅛" by 4" by 16". As in all gun-model making, bore a hole on the inside of the trigger guard, and jig-saw this and the trigger first. Next carefully saw out the side profile, and scribe a center line around the blank so obtained to serve as a guide in whittling. Make the six cardboard templates from the drawings for use in carving the stock and barrel to shape. Bore out the barrel taper to the depth shown in the draw-

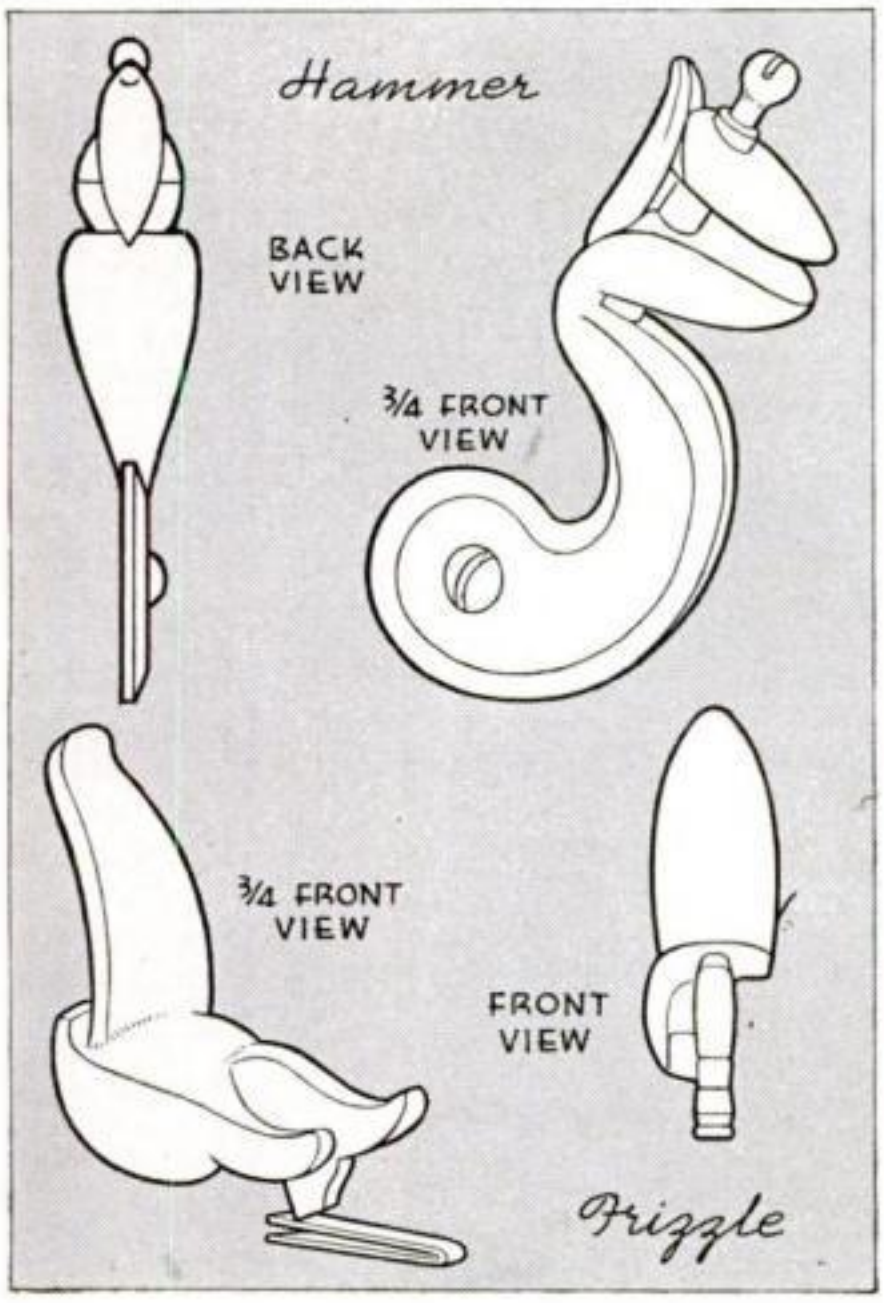


ing before carving the outside. The barrel is octagonal at *K*, but only five of the eight flat surfaces appear in the finished piece.

Sand the entire model smooth before scribing in the decorations, trigger guard, and side plates. Make shallow V-cuts for these, and follow carefully the designs in the drawings. The screws are slotted bits of dowel, glued into holes. The carved portions at *O* and the top of the "metal" butt plate stand out in shallow relief. Markings such as at the three points marked *M* are done with a triangular file. The three ramrod holders *N* are of metal in the prototype.

The hammer and other parts of the flintlock are carved separately and glued in place. Glue together two pieces to make the spring under the frizzle, or "steel" plate which is struck by the flint, and sand the joint round. Do the actual carving of the trigger and its guard last since they are the most fragile parts. Use a very sharp knife, and cut across the grain first to prevent splitting. Should a part break while carving, glue it back, and let it dry thoroughly before proceeding.

The model can be left natural color, as some whittlers prefer, or the various parts can be stained and blackened to represent wood and metal respectively. A pine frame around a piece of plywood, to which the model is fastened with a single screw, sets it off to advantage.



Realistic Blue-Steel Finish

ON WHITTLED GUNS

FLINTLOCKS, butt plates, barrels, and similar "metal" parts of whittled firearms and other models can easily be given a realistic blued-steel finish. After the piece has been sanded smooth, apply a thin coat of *flat* black paint and let this dry overnight. Then rub with powdered pumice until the paint is worn down and the wood shows through slightly. Clean the pumice off and rub powdered graphite in well with a soft cloth. When the wood will absorb no more, blow off the excess. A thin coat of clear varnish is now applied with a minimum of brushing. Let dry overnight; then rub in powdered graphite again. Handling may rub off some of the outer graphite coating, but this can be renewed as required. The models above were finished this way.—PAUL H. RAGON.

CAR-TOP BOAT

FOR FISHING, HUNTING, AND FAMILY USE

Designed for general use, this plywood boat has ample stability for large bodies of water and is light enough to be carried on a car. Its modified V-bottom gives good speed with an outboard motor

By Bruce and Willard Crandall

OUR new plywood boat *Tops* is designed for the man who wants a portable, all-around utility boat for fishing and hunting trips or family use. It can be taken anywhere on top of the car and has the advantage of not requiring a trailer in these days when the tire problem is so acute. There are, of course, no planking seams to open up in the hot sun.

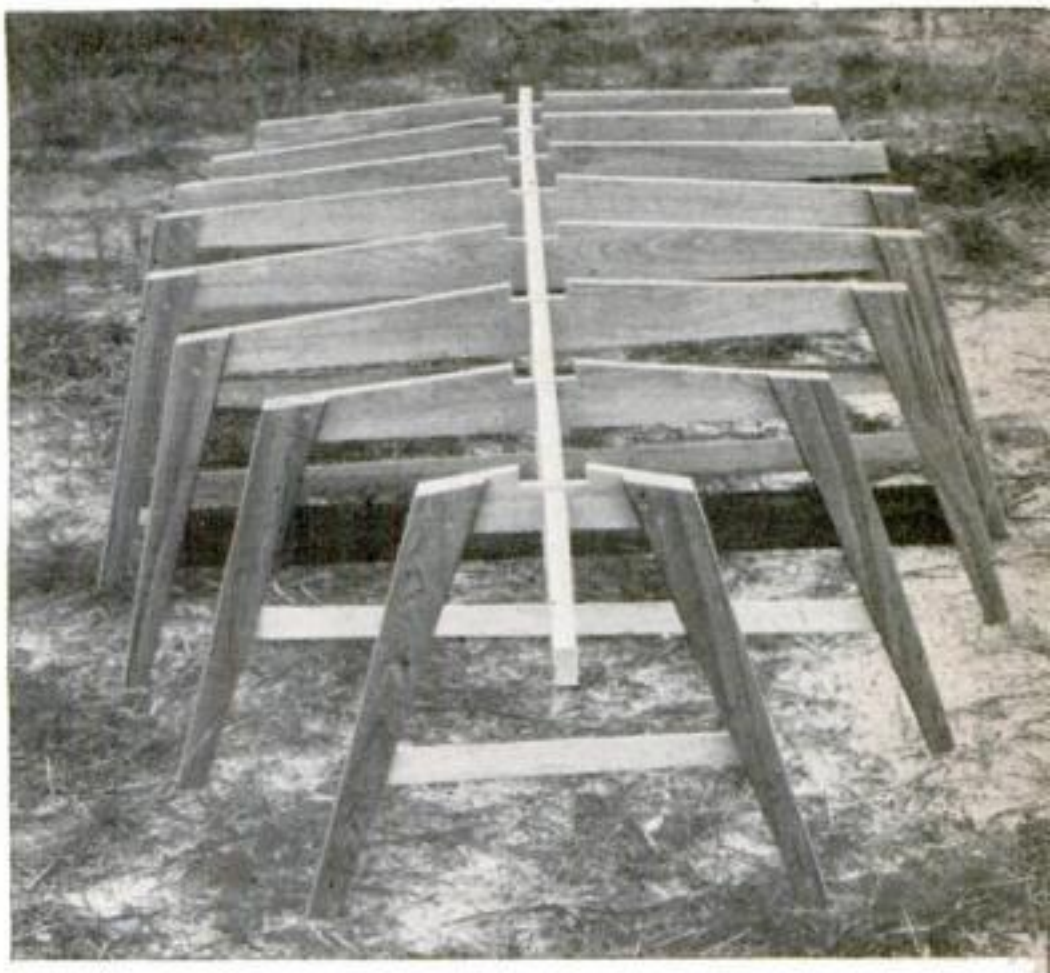
Tops may be used on any water, from small creeks or inaccessible lakes to larger, open bays. With an inexpensive commercial car-top rack of the suction-cup type, or a homemade rig similar to the one shown in the photograph at the left, transportation of this lightweight boat is no problem at all. Or, if only short trips are to be made by automobile, the boat may be tied in place on the car roof, provided sufficient padding is used to prevent chafing.

Inexpensive to build, *Tops* is a good utility boat for use at a bathing beach. A small outboard, of from ½ to 3 h.p., will drive it efficiently; and because of its light construction and V-bottom design, it is easy to row. As it can be carried by one man, it need never be left in the water.

The use of plywood simplifies the job of planking. No rabbeting, steam bending, or complicated construction work of any kind is required. The framework is strong enough for ⅛" plywood to be used for planking in case the boat often has to be portaged to hard-to-reach lakes or streams. The use of ⅛" plywood over a light spruce or cedar framework will bring the weight of the entire boat down to as little as 60 lbs. and there will still be sufficient strength

for ordinary use. The construction is so arranged that either half of the bottom can be removed quickly and replaced by a new piece of plywood should any serious damage be caused by hitting submerged rocks or stumps.

The first step in building the boat consists of drawing full-size patterns of the frames, transom, and stem on wrapping paper, following the measurements given in the drawings. The measurements given in the table of offsets are for use only if it is desired to draw the entire boat full size before drawing the frames. This table gives the measurements at each station, taken horizontally from the center line and vertically from the base line, making it unnecessary for the builder to scale the line drawings, but it does not include allowances for planking thickness or for the transom angle and bevels. The spacing of the sta-



Inside view of the assembled transom and, at top right, the assembled frames temporarily placed on the keel form before the latter is set up. The boat is built upside down

SPECIFICATIONS IN BRIEF

Length	10' 9"
Beam	48"
Draft	4"
Depth amidships	17"
Weight	60—95 lbs.
Cost of materials	$20—$25
Motors (outboard)	½—3 h.p.
Speed	4—8 m.p.h.

MATERIALS FOR THE CAR-TOP BOAT

LUMBER

Waterproof marine plywood

For	No. Pc.	Size
Planking, seats, floor	1	⅛" or ¼"x 4' x10'
	1	⅛" or ¼"x 4' x12'
Transom	1	¼" or ⅜"x15"x38"

Spruce, mahogany, oak, fir, cedar, cypress, pine, or redwood

Frames and transom frame	2	½"* or ¾"*x4"x16'
Seat framework and outside transom frame	2	½"* or ¾"*x1¼"*x16'
Keel and misc.	1	⅝"* or ¾"*x4"x10'
Keelson	1	⅝"* or ¾"*x3"x10'
Chines	2	¾"*x1¼"*x12'
Sheer battens	2	½"*x1¼"*x12'
Inwales	2	½"*x1¼"*x10'
Stem and stem knee	1	1¼"* or 1¾"*x6"x 3'
Breasthook and transom knees	1	1¼"*x8"x4'
Motor block	1	½"* or ¾"*x8"x15"
Gunwale (half-round)	2	¾"* or 1"*x12'

Any cheap lumber

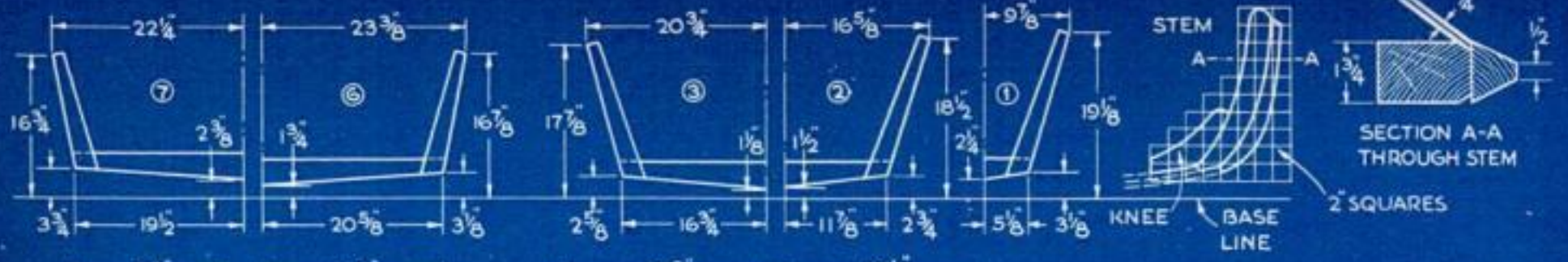
Keel form	1	1"x6"x10'
Uprights and braces	3	1"x2"x16'

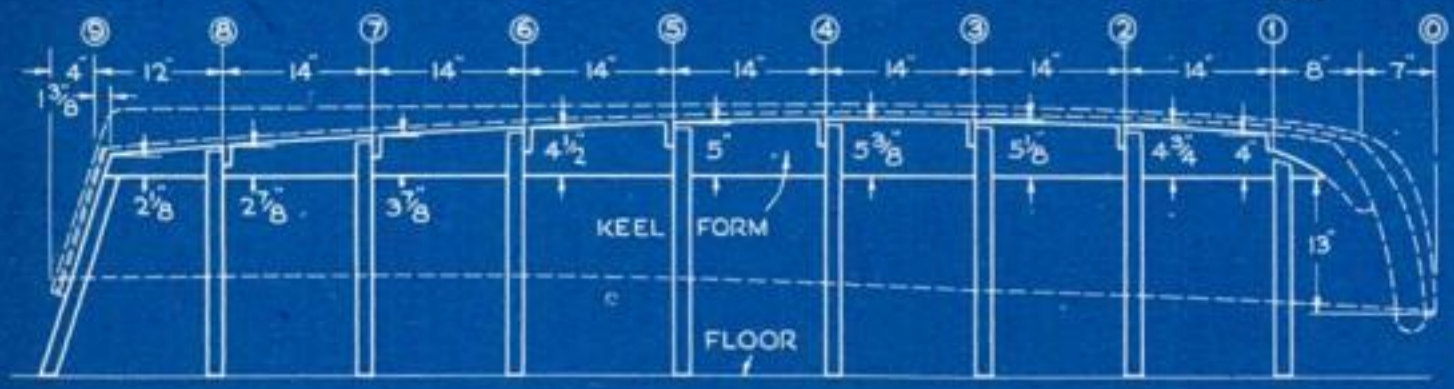
HARDWARE AND MISCELLANEOUS

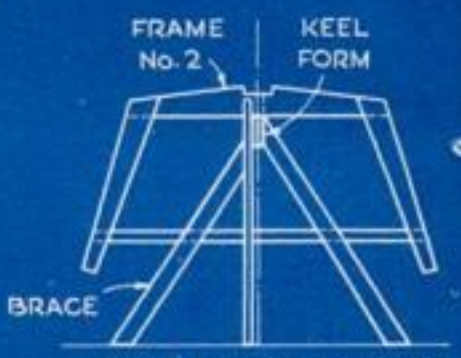
Flathead bronze, brass, galvanized iron, or cadmium-plated screws, as follows: 3 gross ¾" or ⅞" No. 7, 4 gross 1¼" No. 7, 6 doz. 1½" No. 8, 3 doz. 2" No. 10, 4 doz. 2½" No. 12, 4 doz. 1½" No. 10 or 4 doz. 1½" No. 10 machine screws and nuts.

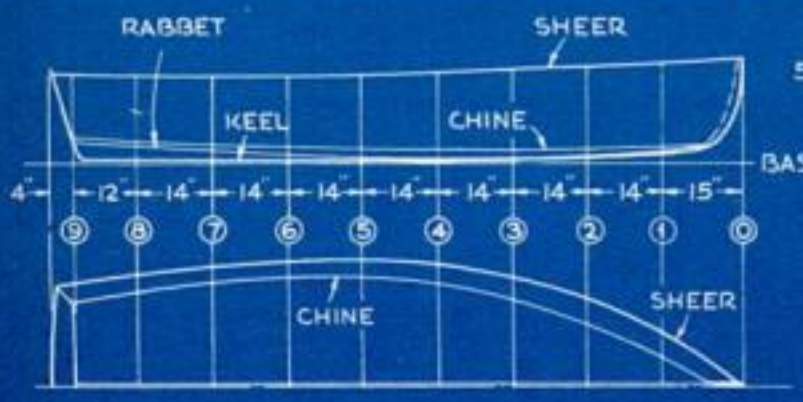
Two feet of ½" half-oval brass or galvanized iron; 1 pt. marine glue (aviation or C-quality); 1 qt. resin primer; ½ gal. marine paint; 1 qt. spar varnish; oars, oarlocks, and other fittings as desired.

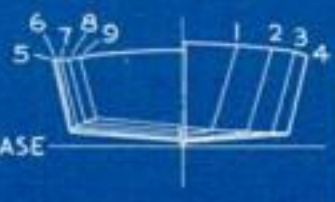
NOTE: Measurements marked with an asterisk (*) are net. The kinds of material are given in the order of preference.











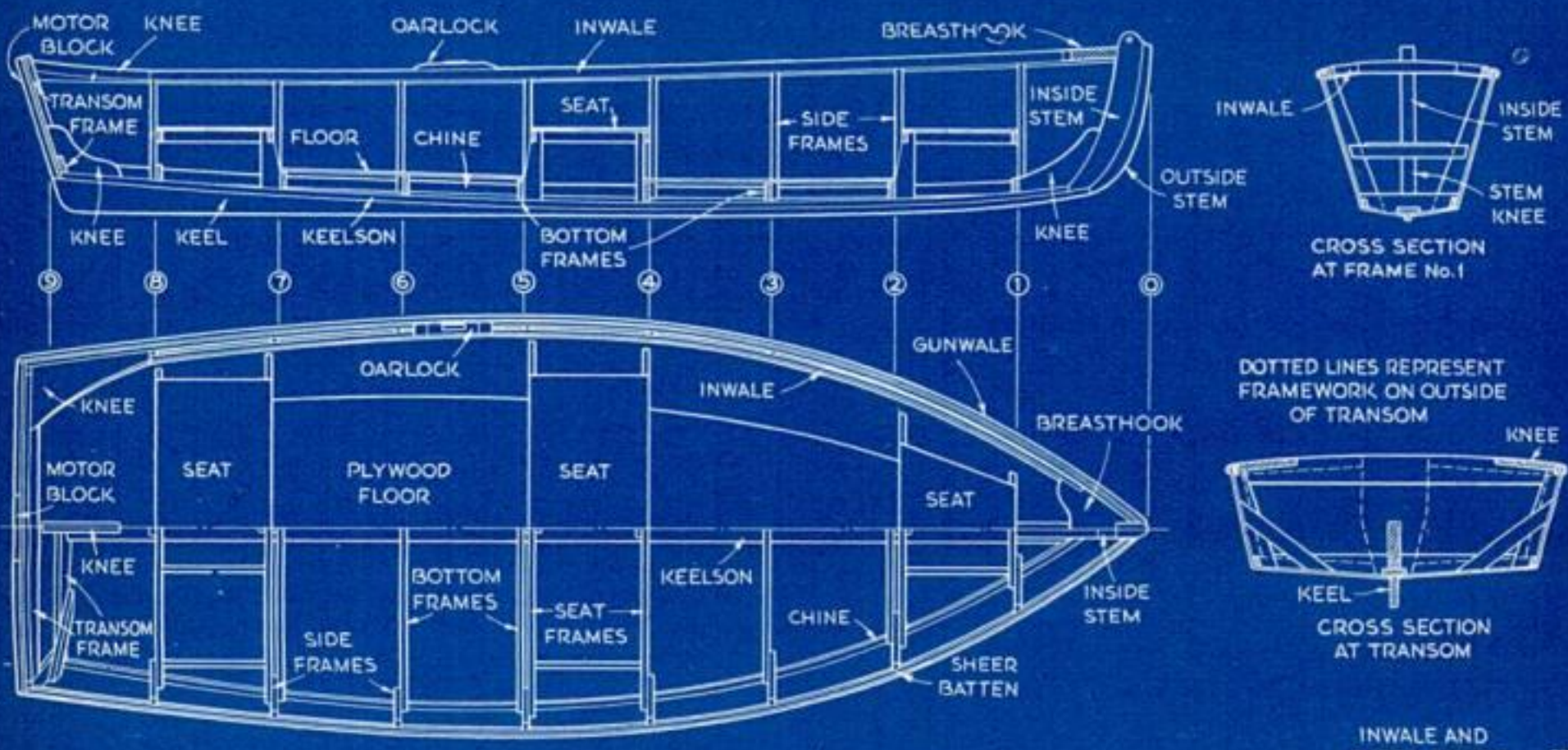
DIMENSIONS

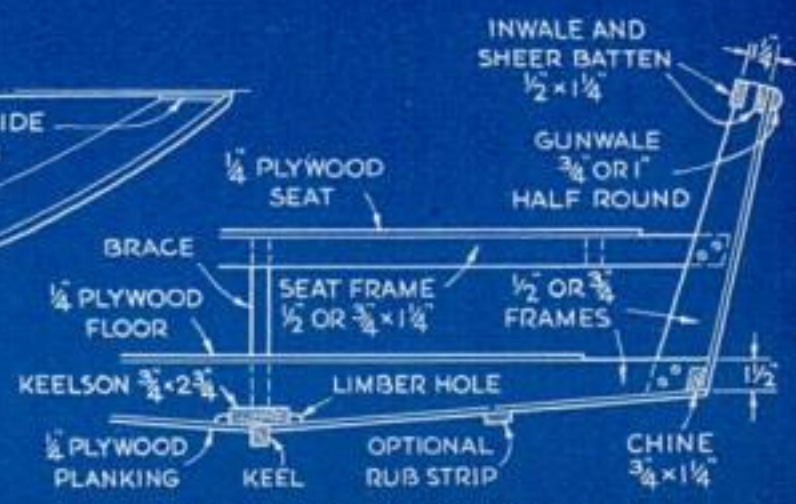
LENGTH	10'-9"
BEAM	48"
DRAFT	4"
DEPTH	17"

TABLE OF OFFSETS

DIMENSIONS IN INCHES AND EIGHTHS TO OUTSIDE OF PLANK

STATION	0	1	2	3	4	5	6	7	8	9
HALF BREADTHS										
SHEER		10-1	16-7	21-0	23-3	24-0	23-5	22-4	21-0	19-0
CHINE		5-3	12-1	17-0	19-6	20-7	20-7	19-6	18-0	16-0
HEIGHTS FROM BASE										
KEEL	3-0	1-4	0-6	0-3	0-1	0-2				0-4
RABBET	3-4	2-0	1-2	0-7	0-5	1-0	1-4	2-1	3-1	4-0
CHINE	3-4	2-7	2-4	2-3	2-3	2-4	2-7	3-4	4-2	5-0
SHEER	20-0	19-1	18-4	17-7	17-3	17-0	16-7	16-6	16-6	17-0





tions and other measurements that cannot be given in the table of offsets are shown on the plan and profile drawings.

Each bottom frame is made from one piece and should be 1½" deep at the chine. Two side frames are made by ripping a 4" board. The frames are lapped at the chines and may be fastened with 1½" No. 10 screws; but if material less than ¾" thick is used for the frames, copper rivets or bolts should be used instead. When fastening the frames at the chines, be sure to allow enough space for the chine notches and for the beveling of the forward frames.

The transom assembly consists of an outside and inside transom framework with a plywood transom between. The joining surfaces are first coated with marine glue; then the parts are fastened together, all slightly offset to allow for the transom angle. For fastening, 1¼" No. 7 and 1½" No. 8 screws should be used, or shorter screws if the framework is only ½" thick.

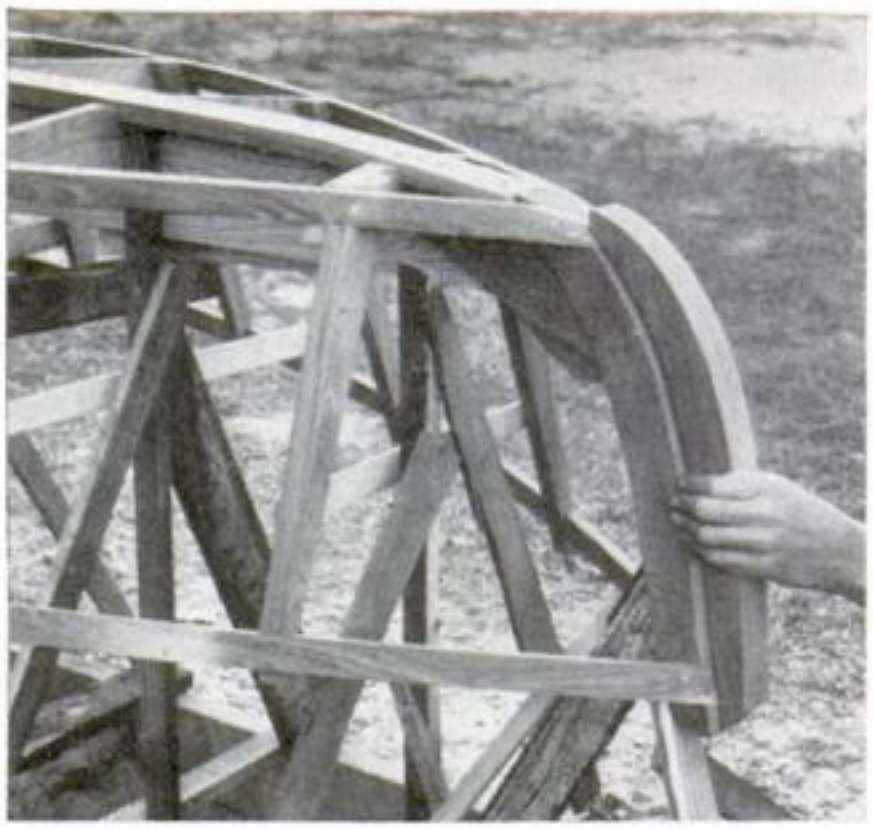
Next, nail temporary pieces across the top of the side frames and mark the center line on these pieces, on the bottom frames, and on the transom. Notches for the keelson can now be cut in the bottom frames and inside transom frame.

When cutting out the stem, saw it down the rabbet line as well, and save the outside piece to be put on after the boat is planked. In this way all the work of rabbeting the stem and fitting the side planks into the rabbet is eliminated. This is a very simple way to make the stem, but quite adequate for a boat of this type. Of course, the two parts of the stem must match accurately, and the knee should be carefully fitted and made long enough to accommodate plenty of fastenings. The joining surfaces themselves should be coated with marine glue before fastening.

The boat should be built upside down, supported

Frames in place, the stem is checked (at left) to see that it is plumb. Below, sheer battens are clamped on for marking the notches. Leave room for putting on inwales

Beveling the transom ready for the planking. The chines and sheer battens are notched into the frames

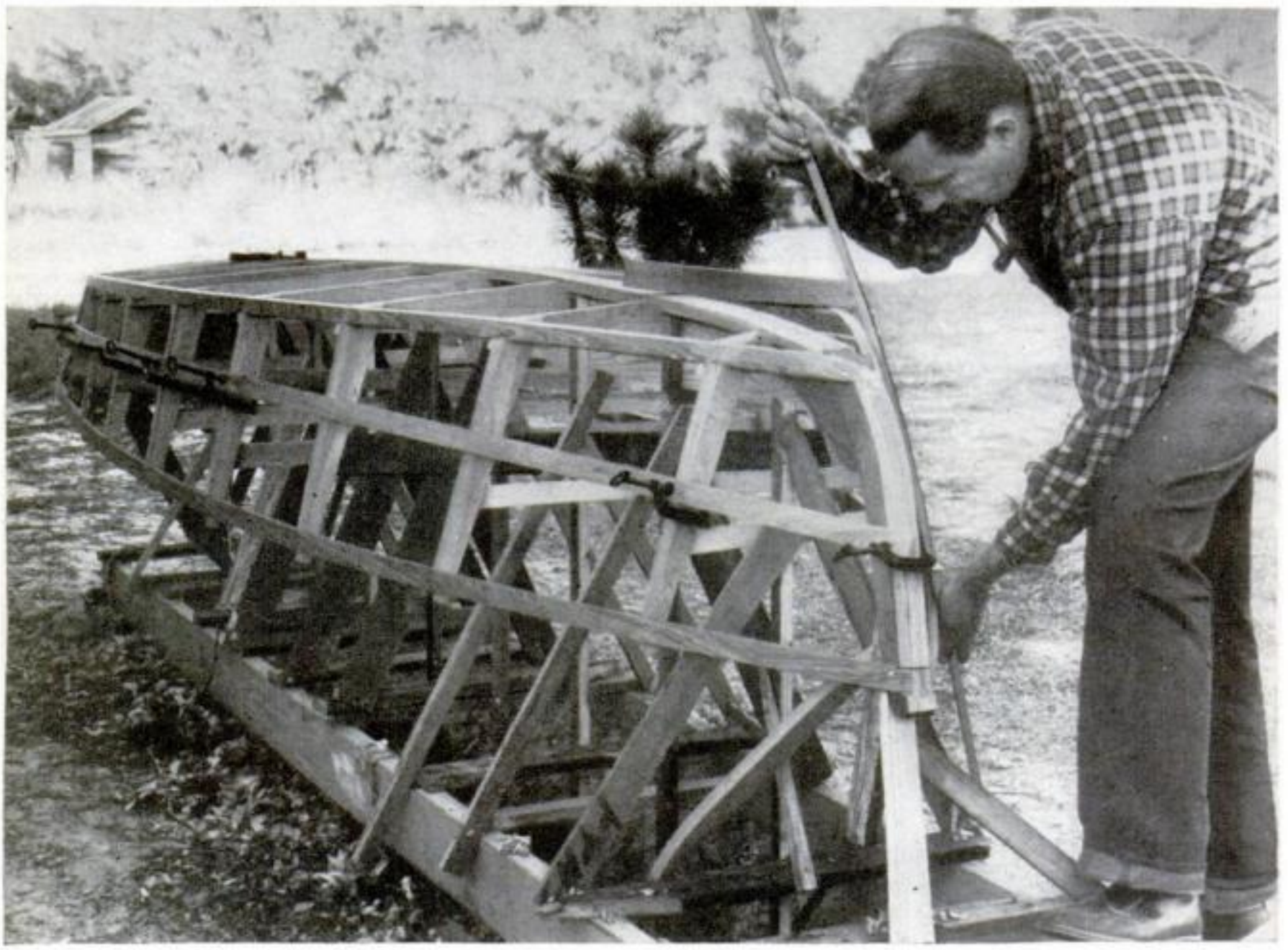


This is the entire stem in position, but the outside stem is fastened after the side planking is on

from the floor or from two timbers as shown in the photographs. The keel form, which is the essential part of the framework, is cut from a 1″ by 6″ plank according to the measurements given in the drawings, and notches are cut at the proper points just deep enough so that each keelson notch will be flush with the edge of the keel form. Nail uprights to the keel form at each station, set the form up, and brace it at a convenient height for working. The uprights should all be perfectly plumb and at right angles to the keel form.

All frames can now be placed in the

Checking bevel of the chine and side to be sure the planking will fit. Battens help in fairing side frames



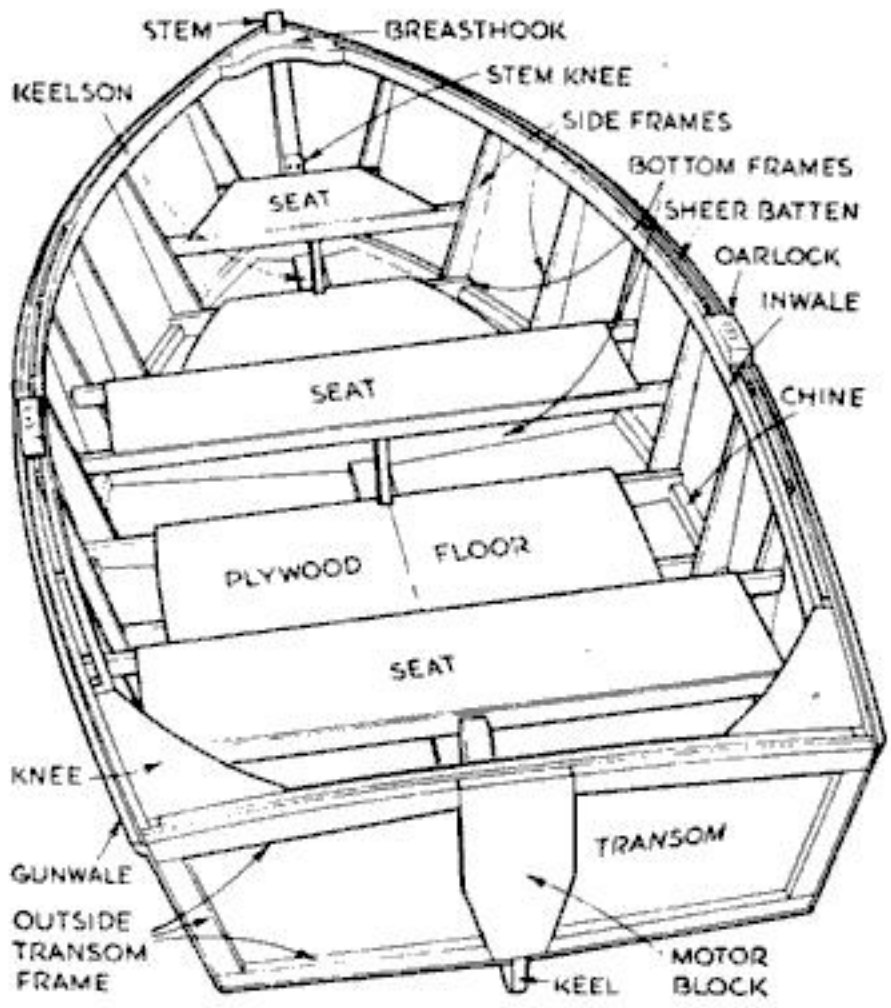
notches and temporarily fastened to the uprights in such a way that their center lines are perfectly plumb and at the center of the keel form. As shown in the drawings, frames 1 to 5 should have the side frames ahead of the bottom frames, whereas 7, 8, and 9 should be just the reverse. The inside stem, stem knee, and transom can now also be temporarily fastened in place. Make sure that the stem and the center line of the transom are plumb and that the keel form is perfectly straight.

As the next step, fasten the keelson in position and cut the notches for the chines and sheer battens. Clamp a batten in position before cutting the chine notches, to make sure of a fair curve and to get the proper angles of each chine notch. Dress down the chines at the stem, rather than cut the notches too deep, as this might weaken the stem.

The chines are fastened with 1½" No. 8 screws, and both chines should be bent into position at the same time to prevent pulling the framework out of line. Use screws of the same size to attach the keelson to the bottom frames, and 2½" No. 12 and 2" No. 10 to hold the stem knee to the inside stem, keelson, and frame No. 1. The sheer battens are fastened with ⅞" No. 7 screws.

Before fastening the chines, make sure that the bottom frames are at right angles to the keel form; and before fastening the sheer battens, check to see that the side frames are plumb.

Next, the frames, transom, chines, keelson, and stem should be cut to a bevel in such a way that the planking will fit perfectly. The entire framework must be carefully faired up so that the sides and bottom will bend in a perfectly smooth curve. This can be checked by bending a batten over the frames, stem, and transom at various places fore and aft, and then standing off at a distance to determine if the batten bends in a pleasing curve, yet touches each frame. The inside stem should be dressed down enough to allow the outside stem, when it is attached, to cover the ends of the side planking.



Detailed sketch of the interior of the completed boat, giving the name and position of each part

(To Be Concluded)

ELECTROPLATING WITH NICKEL [ELECTRICAL]

Nickel plating. Next to copper, nickel is probably the most useful plating metal. Except in the case of certain cutting and machine tools, the work should first be copper plated unless it is made of copper or brass having a high copper content.

To make a nickel electrolyte, dissolve in 1 gal. warm water:

8 oz. nickel ammonium sulphate
4 oz. nickel sulphate
2 oz. ammonium chloride

This solution is best used at a temperature of 130 deg. F. Under normal conditions, at 2½ volts, the deposit will be sufficiently heavy in from 15 to 25 minutes.

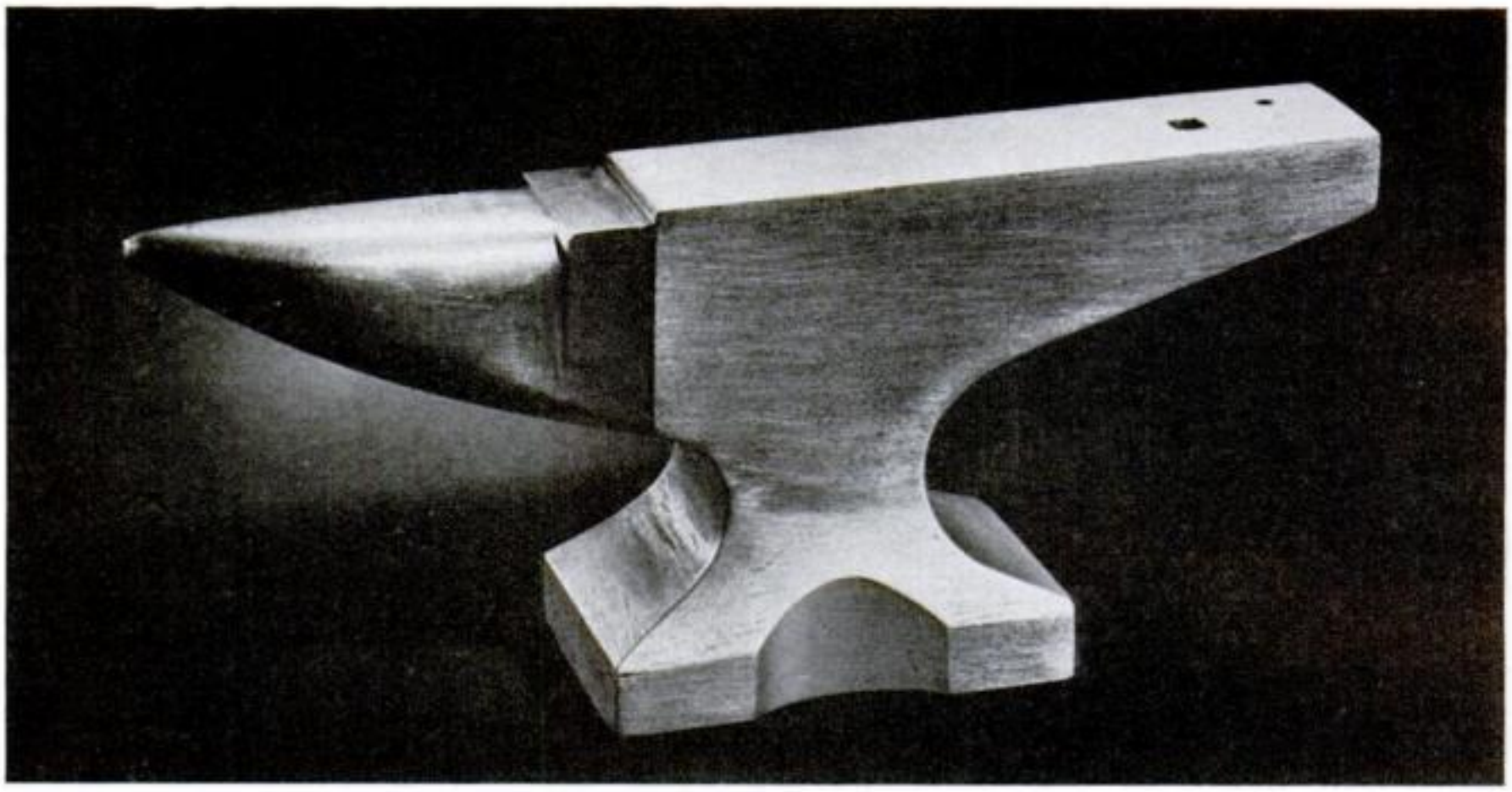
Formation of hydrogen bubbles on the work may indicate use of too high a voltage or lowered acidity of the solution. The latter can be tested with blue litmus paper, which will turn red if sufficient acid is present. To increase the acidity, add sulphuric acid a drop at a time until the condition is corrected.

A darkening of the deposit may indicate too low a voltage. It may be necessary to add small amounts of concentrated electrolyte occasionally to maintain the nickel content of the solution.

When placing the work in the solution, jog the supporting rod to dislodge any air bubbles that may adhere and cause pinholes in the deposit.

Anodes may be purchased in rolled plate form or in castings, the latter being preferable as they enter into solution more readily. Should a cast anode have a tendency to cause a sludge in the tank, inclose it in a clean muslin bag, which may be renewed occasionally. Hang the anode far enough from the work to avoid uneven plating. The "throwing power" of nickel is not great, and to plate the inner parts of some work it may be necessary to introduce small anodes into the openings.

POPULAR SCIENCE MONTHLY SHOP DATA



This decorative little anvil, shown actual size above, was modeled after a real blacksmith's anvil

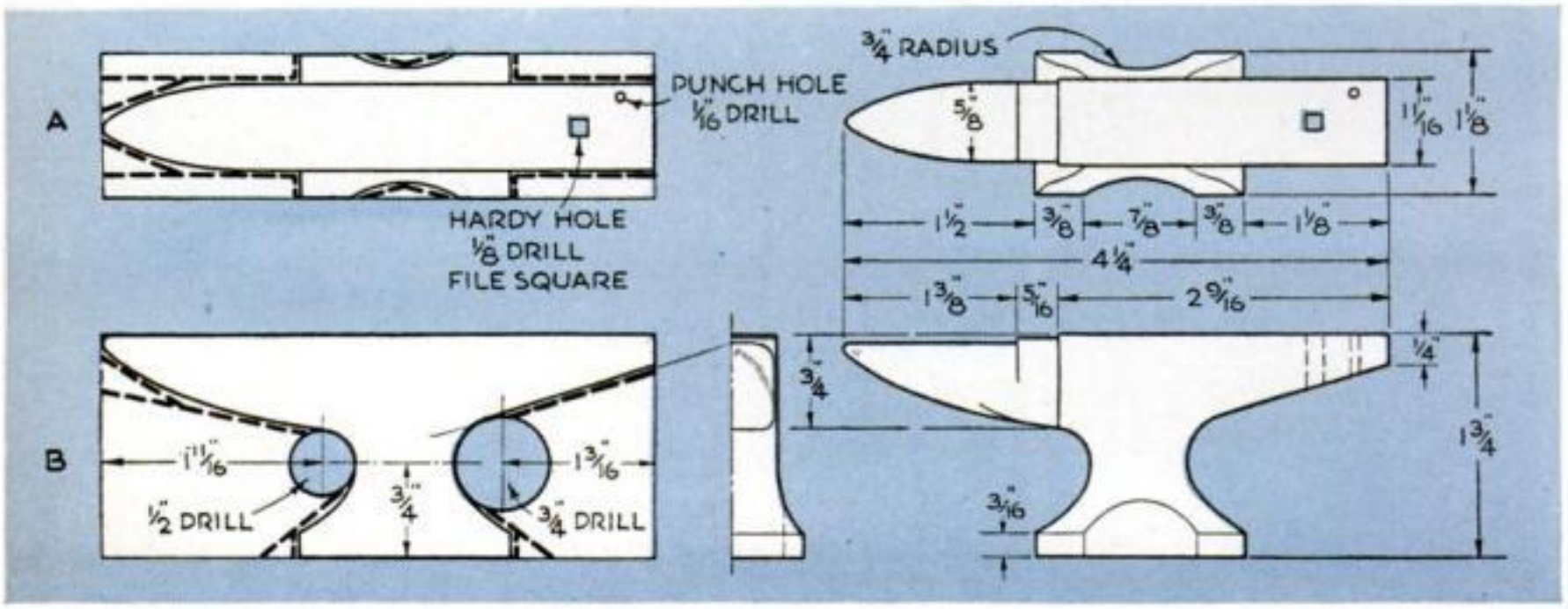
Miniature Anvil
SERVES AS
Paper Weight

By J. W. LAWRENCE

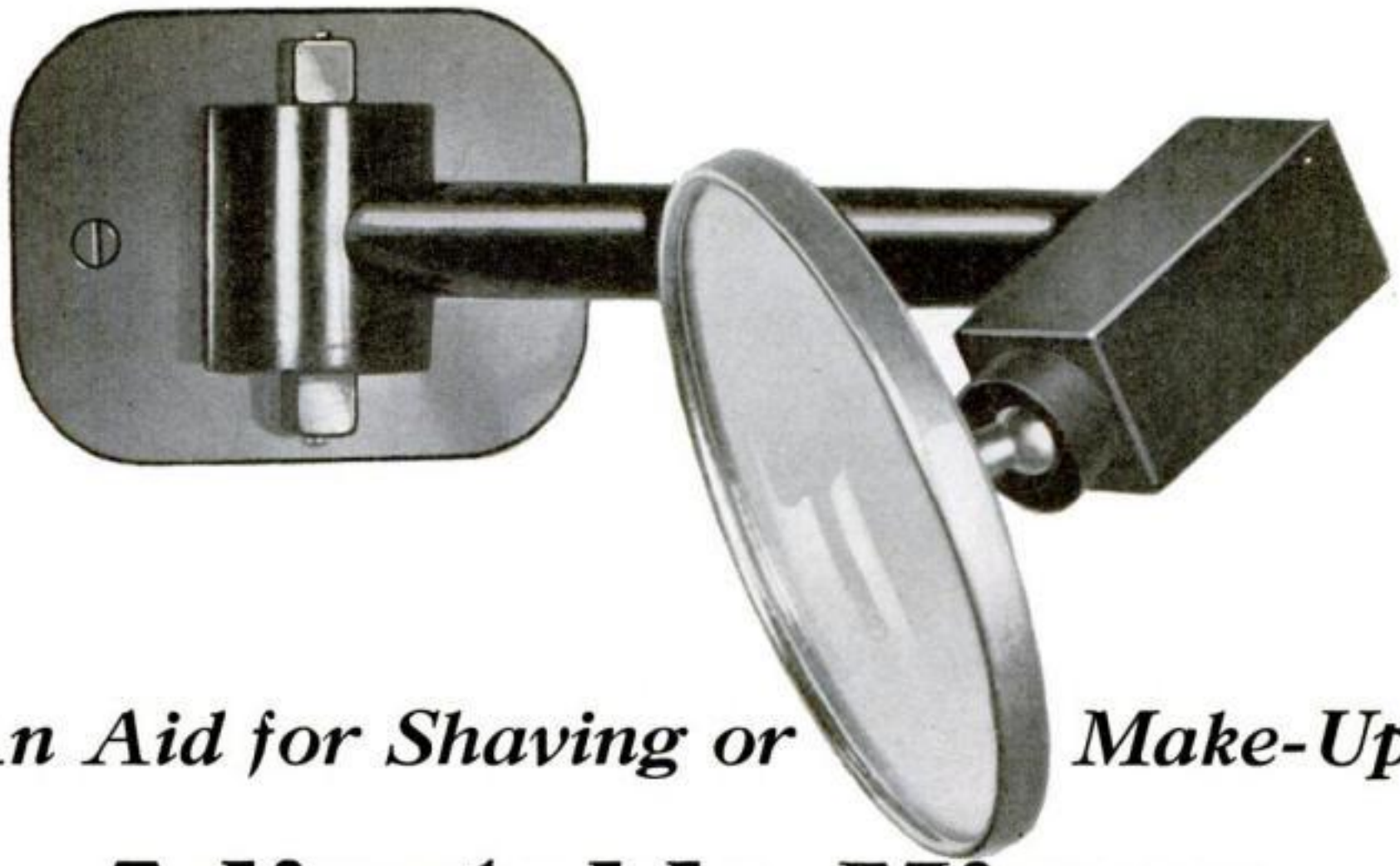
THE anvil in the old blacksmith's shop never looked like very much, but reduce it to a miniature and you see at once the fine proportions and sweeping curves of its sturdy form. A scale model of the size shown in the accompanying drawings is an attractive project, and it can be put to practical use as a paper weight. Made smaller, it could serve as a watch charm or for other ornamental purposes.

The original model was started by scribing the top and side outlines on a 4¼" by 1¾" by 1⅛" block of cold-rolled steel. Holes were then drilled as shown at *B*, and the surplus metal was removed with a hack saw along the heavy dotted lines, after which the block was hack-sawed as shown at *A*. The anvil was then filed to the finished shape. The hardy hole in the top was drilled ⅛" in diameter and filed square with a needle file, after which the piece was polished with emery cloth.

If electroplating equipment is available, the model can be plated with gold, silver, or chromium. Should you prefer to leave it the natural color, it may be well to coat it with clear lacquer to prevent rusting.



The ½" and ¾" holes are drilled in a steel block, the waste sawed off, and the piece filed to shape



An Aid for Shaving or Make-Up

Adjustable Mirror

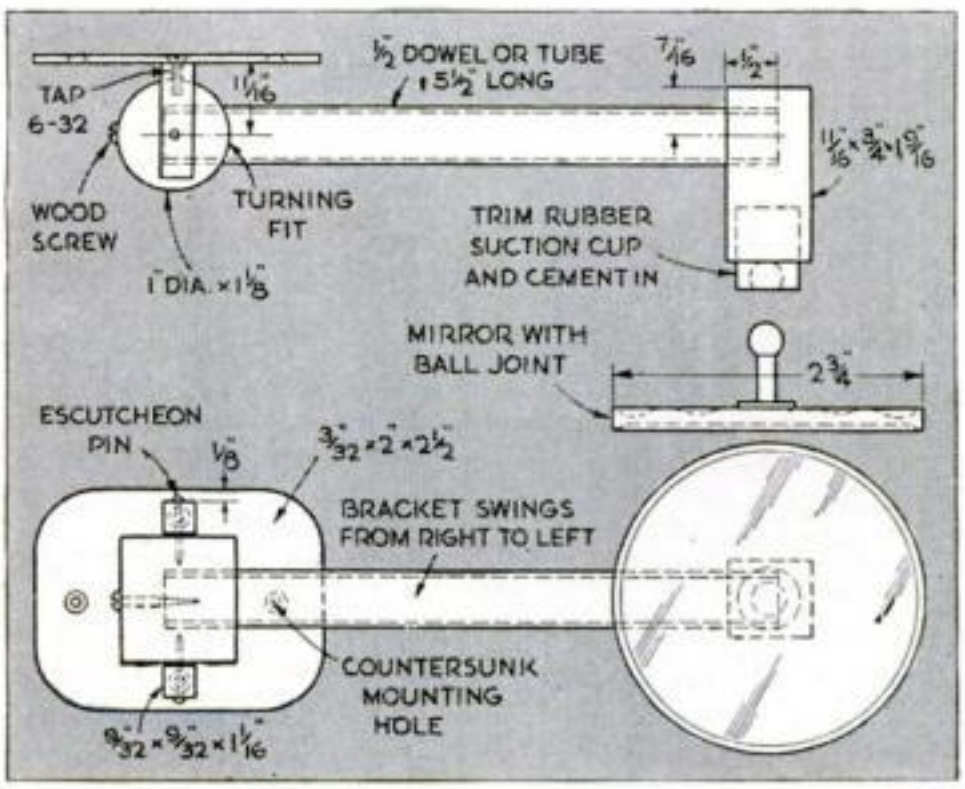
WHETHER you use soap and brush or belong to the motorized shaving division, a better job results if you can see what you're doing. This mirror bracket is instantly adjustable to any angle and will throw light on any part of the face. If you want one for shaving, play safe by making two—because this little accessory happens to be ideal for feminine make-up as well. It can be fastened to the side of a medicine cabinet, to a door, or to the wall or any other vertical surface.

The mirror, which has a rubber suction cup, can be bought at almost any auto supply store for a few cents. Trim the cup so that it can be cemented into the square member of the bracket as shown.

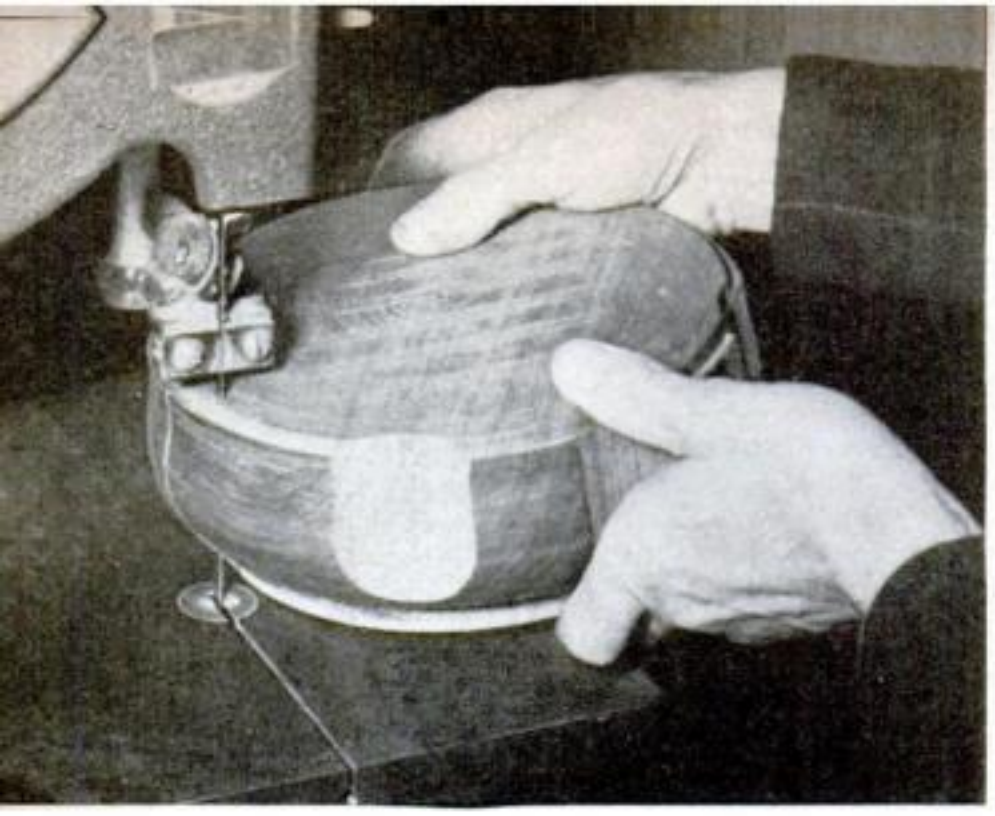
The bracket can be made of phenol-formaldehyde plastic, as illustrated, or of hardwood. If a hollow tube is used for the swinging arm, plug one end with wood so that it may be secured with a wood screw. The screw can then be tightened to provide any desired stiffness at this pivot. The outer end of the arm is cemented fast to the square member that carries the mirror.

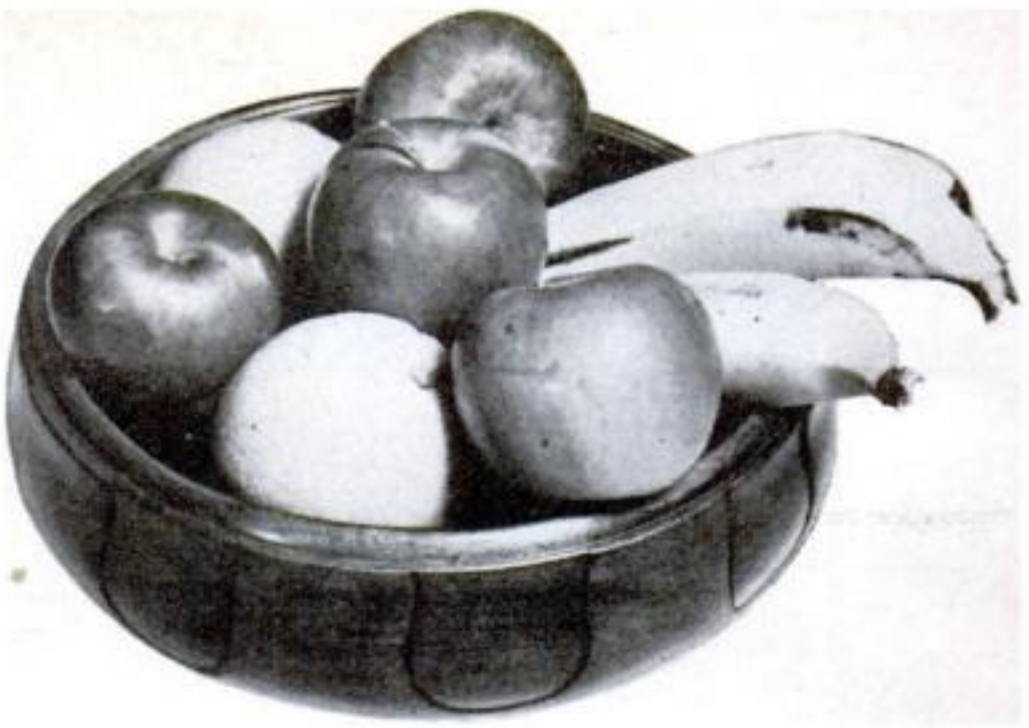
Small square pieces secured to the back plate with machine screws are drilled to a free fit for two escutcheon pins, but these are driven into slightly undersized holes in the round member. Smooth all plastic parts with fine silicon-carbide paper, and buff with fine tripoli or other compound on a cloth wheel.

If plastic is not available, the round parts of the bracket can easily be made of dowel. Thin plywood will serve for the back plate. However, the 9/32" by 9/32" pivot mounts should be made larger—9/32" by 1" by 1⅛" would be an appropriate size, as they could then be rounded at the outer ends to conform to the round piece on the arm. Glue them to the back plate and use two thin wood screws in each for further reinforcement. Wood screws should be used instead of escutcheon pins at the pivot. Enamel or finish to suit. Approximate working time for a craftsman who has had some experience in using plastics, 4½ hours.—ERNEST R. DEWALT.



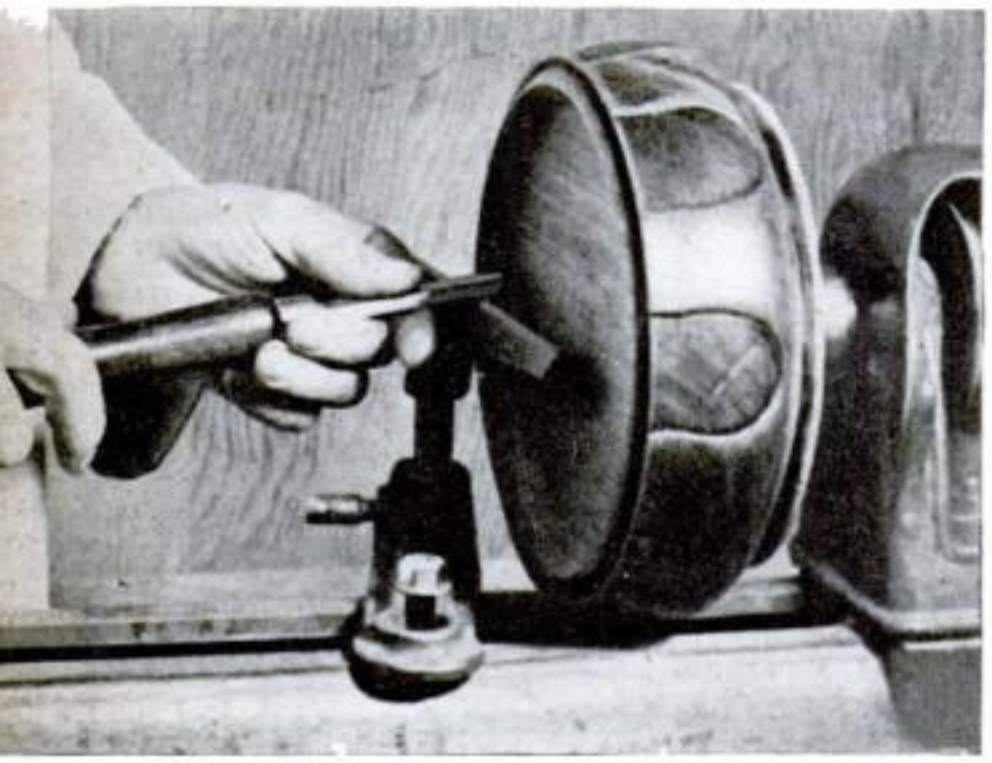
Two adjustments are possible with the mirror constructed as at left: it will swing right or left on the hinged joint, and up or down by turning the round arm in its pivot at the bracket, to take best advantage of any light





Turned Fruit Bowl

DISPLAYS WOOD-CARVED EFFECT

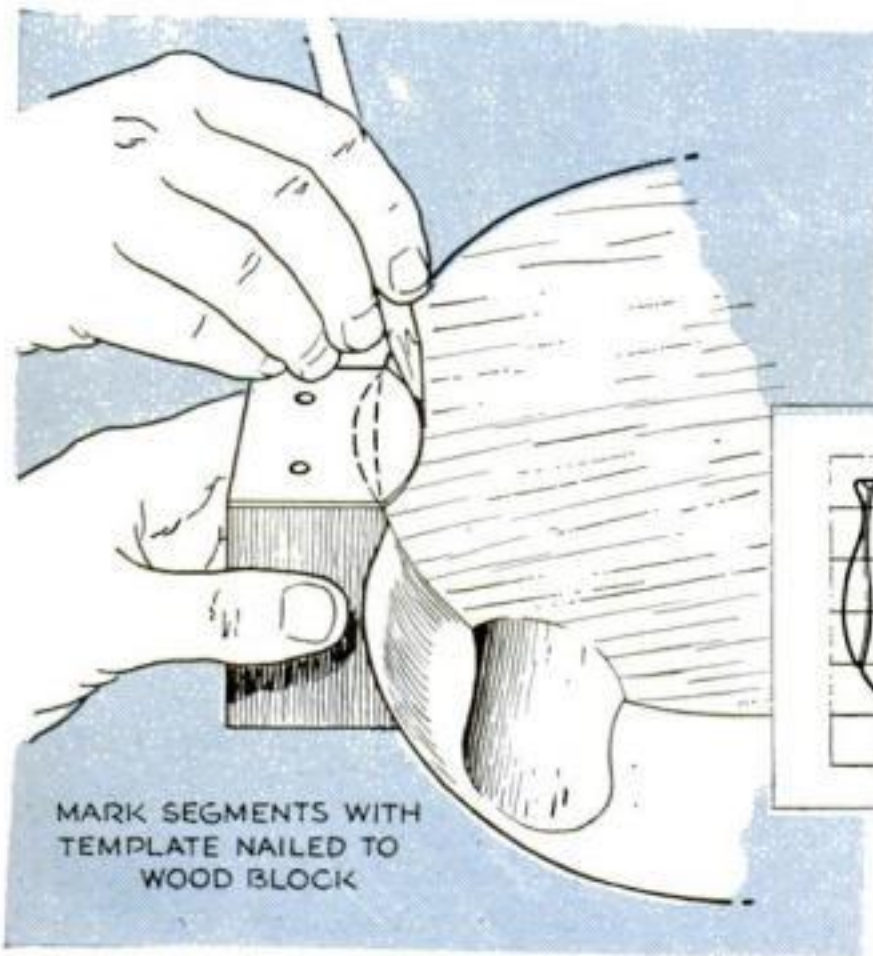


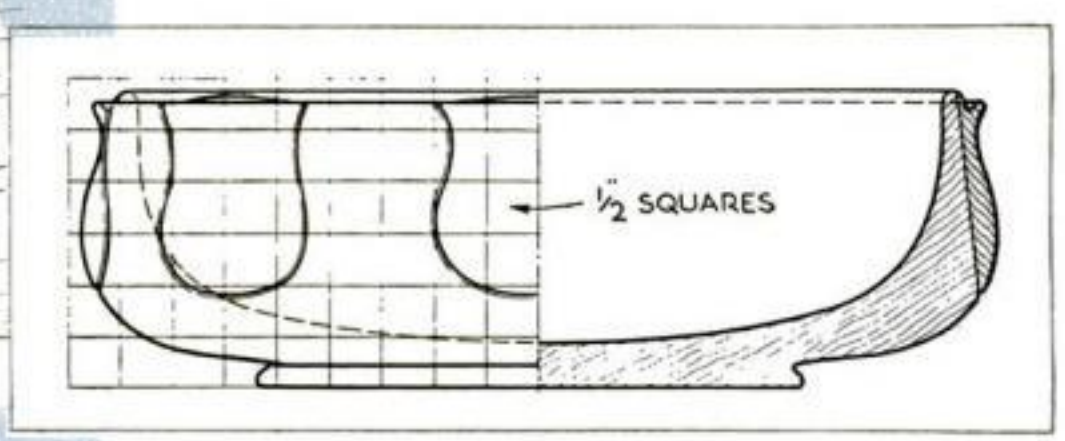
ALTHOUGH the outside of this bowl looks hand carved, the piece was actually made on the lathe and band saw.

A disk 9″ in diameter is first cut from 3″ thick walnut or other hardwood, either solid or glued up from thinner stock. Mount this on a faceplate and turn the outside to the contour shown in the drawing.

Use the indexing head of the lathe or a pair of dividers to mark off eight equally spaced points on the upper turned edge of the work, and with a cardboard template nailed to a wood block draw the curved guide lines as indicated. On the band saw, cut carefully and cleanly along these lines, marking each piece and the point on the bowl from which it was sawed. These pieces are then glued back into place, and will be recessed to a depth equal to the set of the saw blade with which they were cut, producing an undercut or carved effect.

After the glue has set, remount the work in the lathe, turn out the inside, and finish the top edge. Carefully sand all over. Apply several coats of shellac or finish in any preferred manner.—FRANK WHEELOCK.



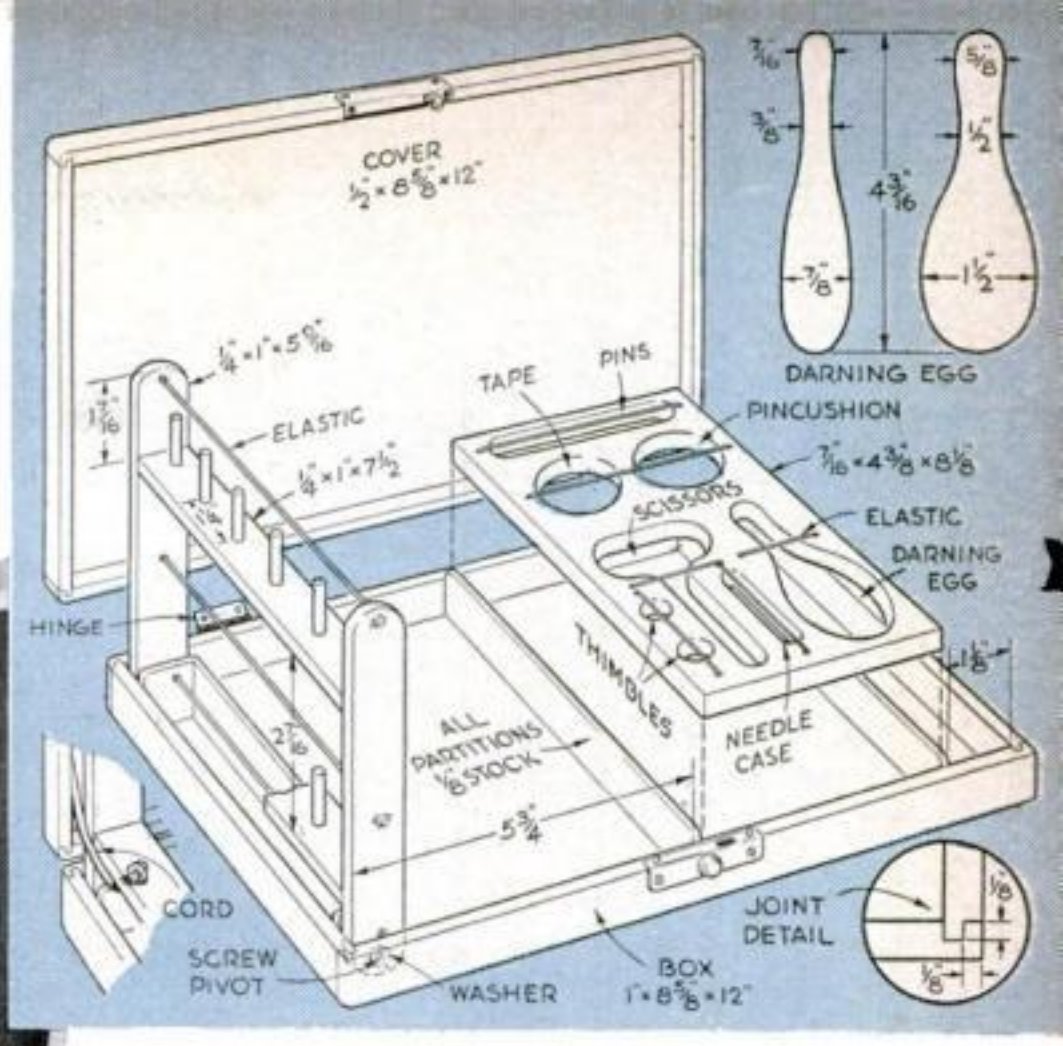


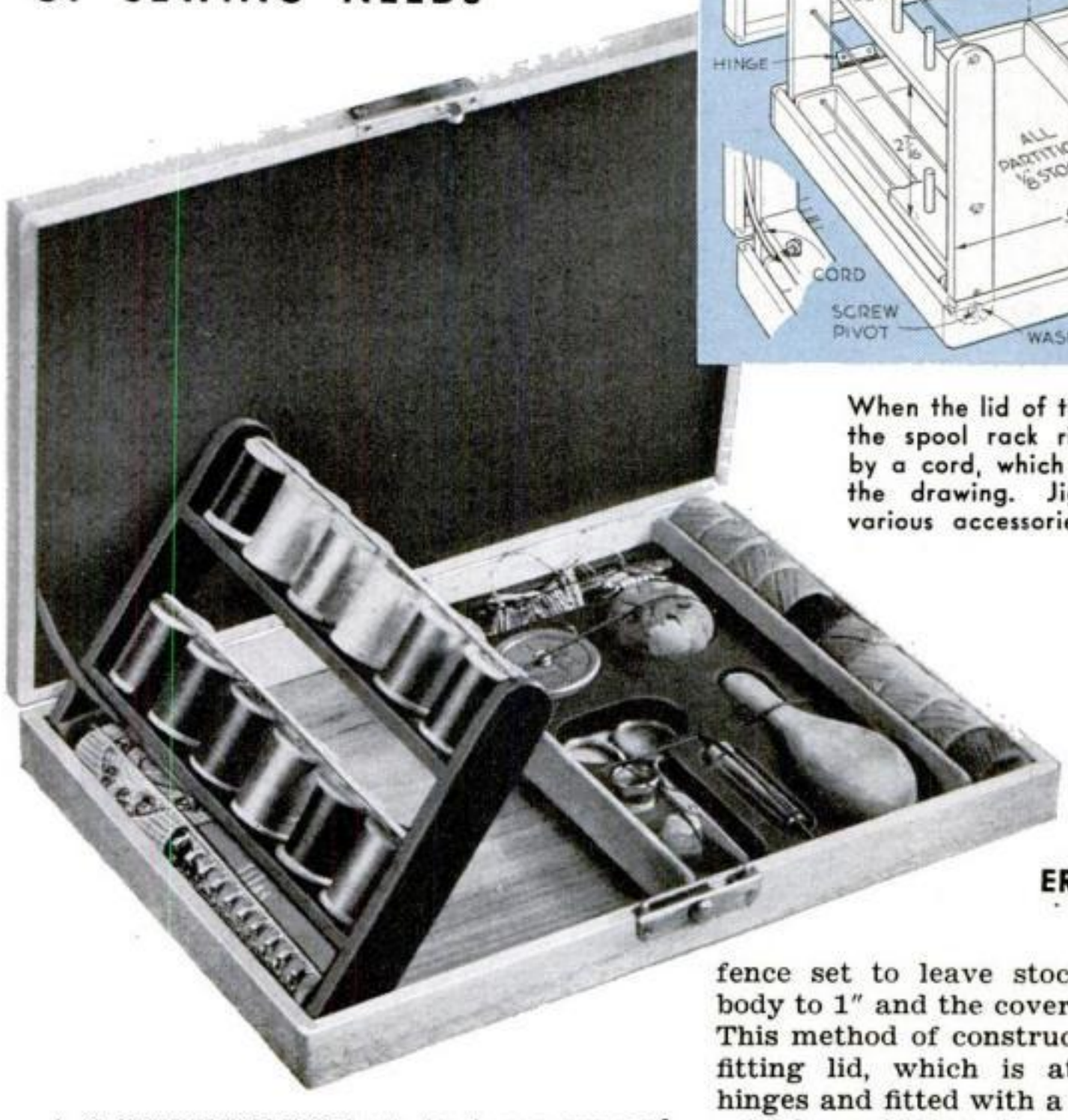
Pattern showing the contour of the bowl and shape of the recessed segments. Mark these as at left, saw them out, and then glue them back in position

Compact

Mending Kit

HOLDS A VARIETY OF SEWING NEEDS





When the lid of the sewing box is raised, the spool rack rises with it, pulled up by a cord, which is shown at the left in the drawing. Jigsawed holes for the various accessories are cut out to suit

Clocked Project

Working Time: Two Evenings

Designed by
ERNEST R. DEWALT

A CONVENIENCE both for home use and for traveling, this sewing kit holds 30 or more darning and mending items in one neat, compact unit. A hinged rack accommodates 12 spools of thread, which are held in by elastic. This rack is attached to the box cover with a cord, and rises automatically when the box is opened. In the upright position, it supports the lid. A fitted compartment holds pins, needles, scissors, thimbles, a measuring tape, a pincushion, and a small darning egg. Various spools of darning thread are kept in a narrow compartment at the right.

The box and lid are made as one from ¼" by 1¾" whitewood. Use end-dado joints at the corners, and set in a top and a bottom of ¼" walnut-faced plywood, both with the veneer side up. Saw apart this 1¾" by 8⅝" by 12" box on the circular saw, with the fence set to leave stock for finishing the body to 1" and the cover to ½" in thickness. This method of construction insures a well-fitting lid, which is attached with small hinges and fitted with a catch.

Make and hinge the spool rack as shown in the drawings. Glue in the partitions. Jigsaw openings in a 7/16" thick piece of pine to fit the scissors and other accessories you wish to use. These parts are best painted dull black before they are set in place. The inside of the lid also is finished a dull black. All other parts are given two coats of clear lacquer. When this is dry, the various pieces of elastic cord are inserted in countersunk holes, drawn taut, and knotted. Of course, elastic will not do for the cord that lifts the spool rack, but a piece of shoelace will serve very well.

As the average darning egg is too large to fit in the case, the one used must be turned down or a new one made from maple or other hardwood. This is a good project on which to practice oval turning. Approximate time, exclusive of finishing, 6½ hours.

First-Aid FURNITURE

For emergency use, the table and chair shown above and the crutch and cot in the drawings may be in demand. Any number of each can be made easily for equipping local defense centers are of folding construction and can be stored in a fairly small space until needed for an emergency.

EFFICIENT and inexpensive furniture for first-aid medical use is a need coming more and more to the attention of local defense councils. Designs for the first-aid cot, table, chair, and adjustable crutch described here were perfected by John McCormack, state supervisor of arts and crafts for the New Jersey WPA, and the pieces are being turned out in quantity by handicapped workers in the WPA's toy-mending and repair project at Newark under the supervision of State Administrator Robert W. Allan.

All four articles can be made easily by amateur craftsmen. The frames for the cot, chair, and crutch should be of a good, strong wood—maple or a similar hardwood is suitable—but the table may be of pine or even scrap lumber. Plywood is used for the table top and for the top of the cot, in the latter instance an important feature, as canvas may be hard to obtain because of military priorities. The cot, table, and chair

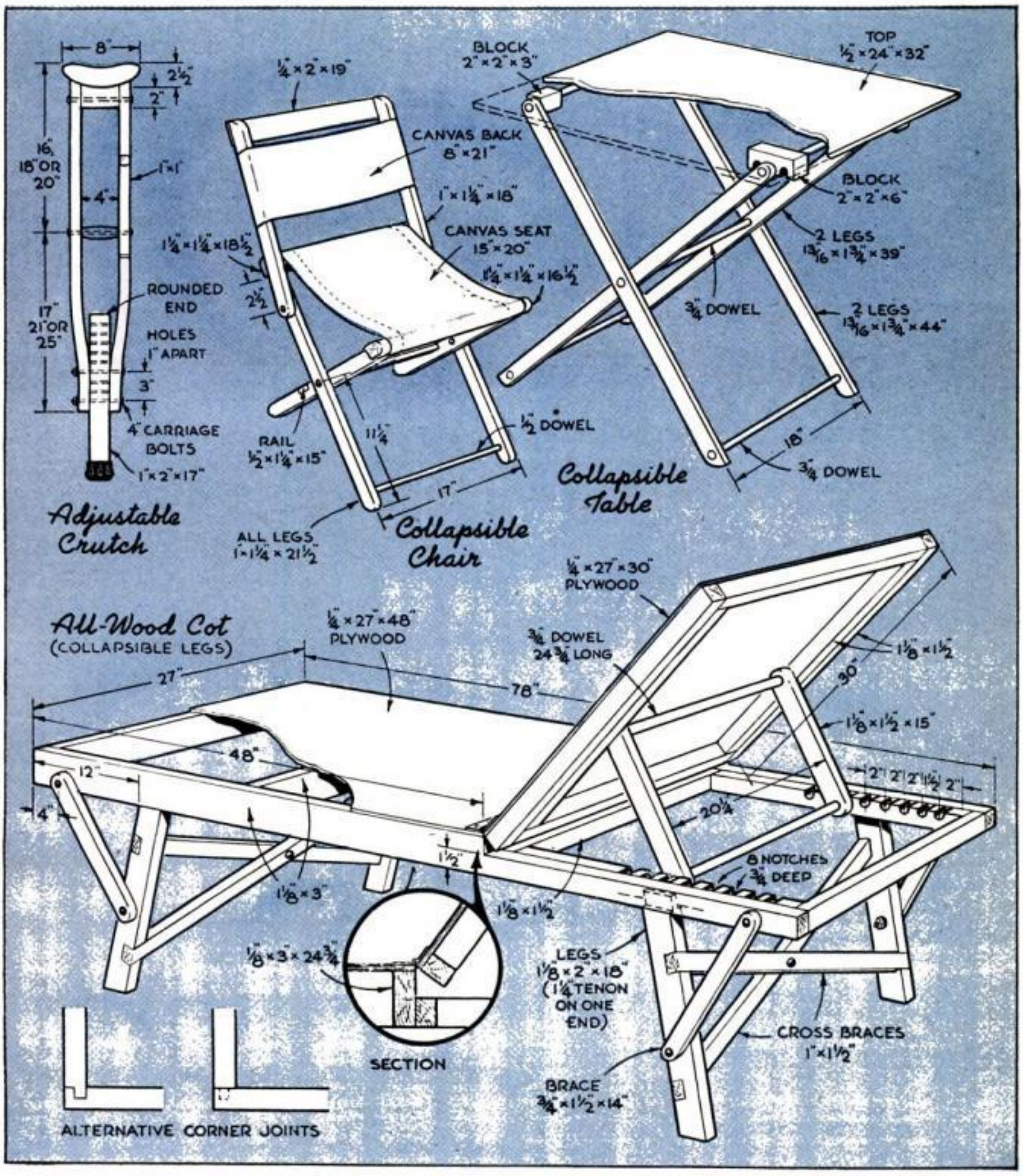
The cot is of regulation length and width, 78" by 27", and is built on a strong frame of 1⅛" by 3" stock. Its legs are constructed in pairs and pivoted so as to fold up against the frame for storage. The mortise-and-tenon joints by which they are held to the frame in the upright position should be snug enough to eliminate play, but not so snug that they cannot be pulled apart by hand when the cot is to be folded for storage.

The top consists of two plywood panels. The shorter piece is attached to an innner frame as shown in the drawing and hinged to the other so that it can be raised or lowered to permit an occupant to recline with his back at an angle. Plywood does not have the "give" of canvas, of course, but it will not be uncomfortably hard if covered with a homemade tufted pad, and it does have the advantage of permitting the hinged back-rest feature. Strips may be placed along the edges to keep the mattress from sliding off.

Much quicker to make is the folding table, several of which will be found useful as stands on which to keep bandages, medicines, and the like. The table has a pine frame with folding sawbuck legs. The underside of the frame is fitted with three sets of notches 1" between centers for adjusting the free pair of legs in order to change the height of the table.

The chair follows the general design of the ordinary canvas-and-wood collapsible camp chair, with the exception that the frame is much heavier, being of 1" by 1¼" hardwood stock. This sturdier construction is necessary to sustain the weight of a person getting first-aid attention.

Really unique is the idea for a crutch adjustable to several heights so that a small center need not keep on hand several pairs of every size. The leg of the one illustrated is adjustable to six heights, and several made in only three sizes should be enough for the average center. The leg is bored for carriage bolts with holes spaced at 1" intervals, and the frame is bored similarly in two places 3" apart. It is essential that the crutch be of such sound construction that it will not break under a man's weight.



Striding Waiter Sets the Pace on This

Kitchen Napkin Holder

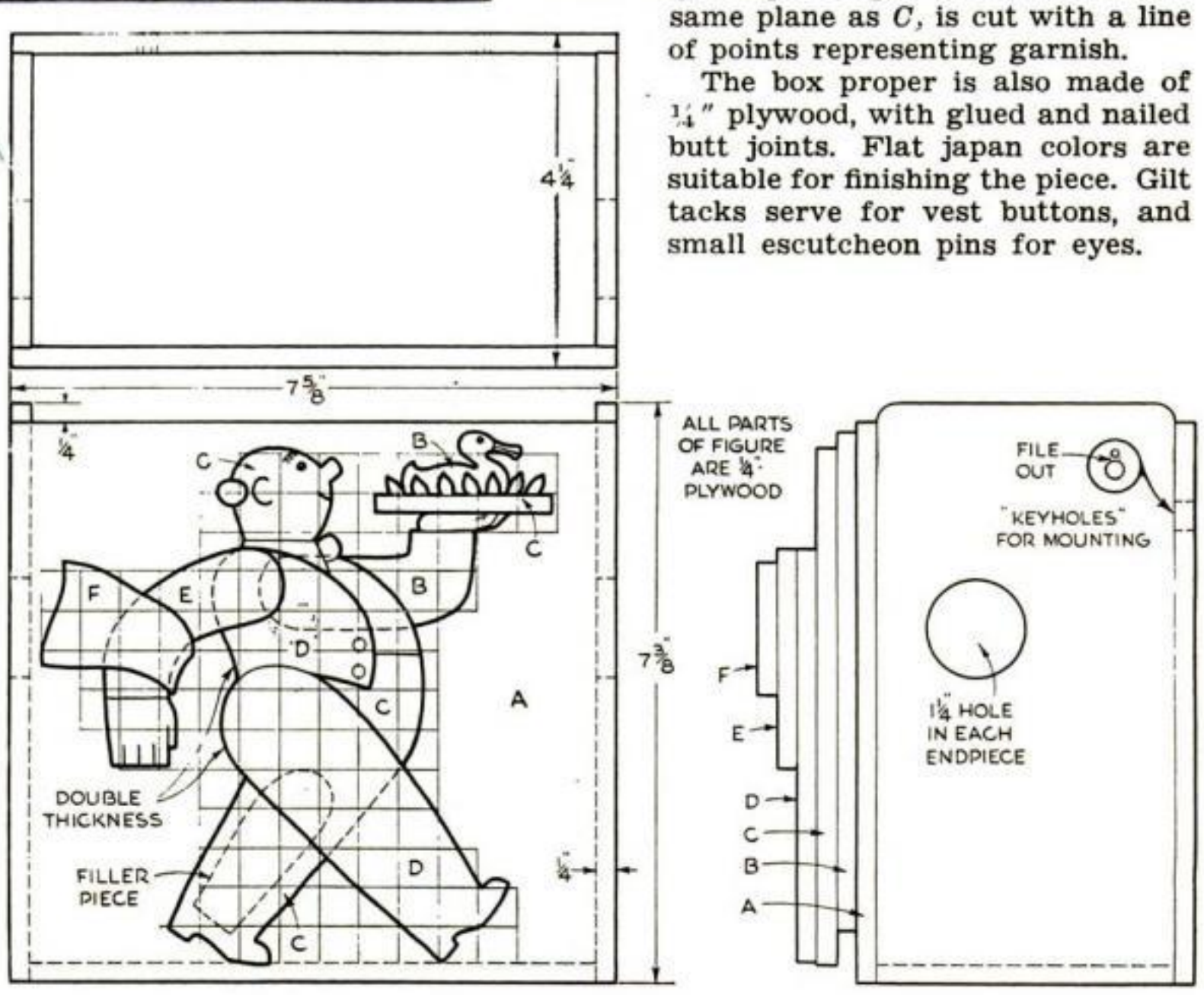
By JUAN OLIVER

IT IS hard to find things in a drawer in which loose paper napkins are kept. This bright kitchen box provides a place for them and strikes an amusing note besides.

Although the figure displays an interesting three-dimensional effect, it is a simple scroll-saw job and requires no carving. Draw the parts on ¼" plywood by means of ½" squares. The letters in the drawing refer to the positions of the parts on the box front, which is marked *A*. Directly to this are tacked the left arm *B*, which may be cut out with the duck and rear part of the tray as one, and the concealed filler piece under the left leg.

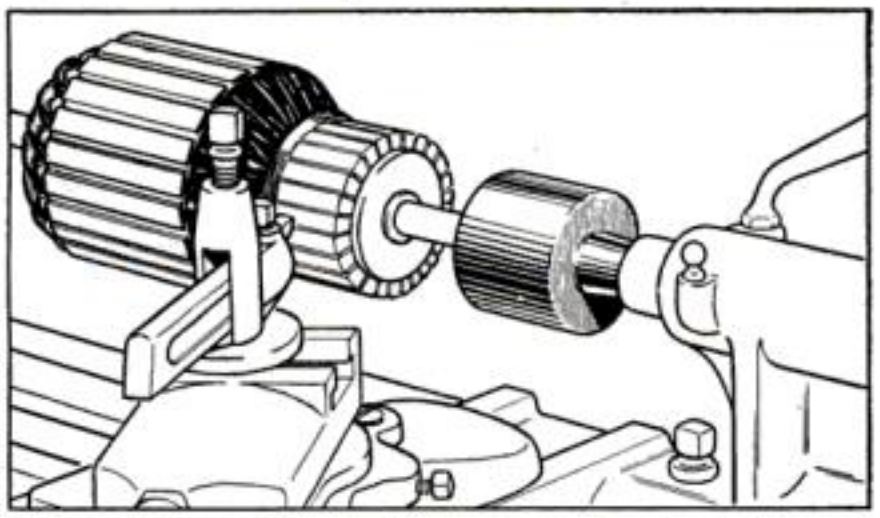
Cut the head, body, and left leg in one piece *C*. Note that this follows the outside line of the shoulder and back, like the following piece *D*, thus forming a double thickness along this part. The vest and right leg *D* are a single piece, the right arm *E* still another, and the napkin *F* the last. The front of the tray, a separate piece tacked on in the same plane as *C*, is cut with a line of points representing garnish.

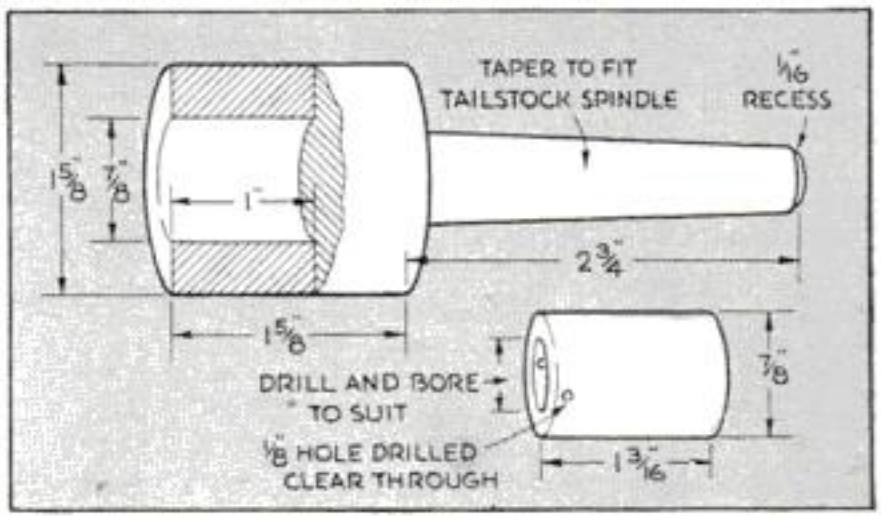
The box proper is also made of ¼" plywood, with glued and nailed butt joints. Flat japan colors are suitable for finishing the piece. Gilt tacks serve for vest buttons, and small escutcheon pins for eyes.



Lathe Tailstock Support Holds Centerless Armature Shafts

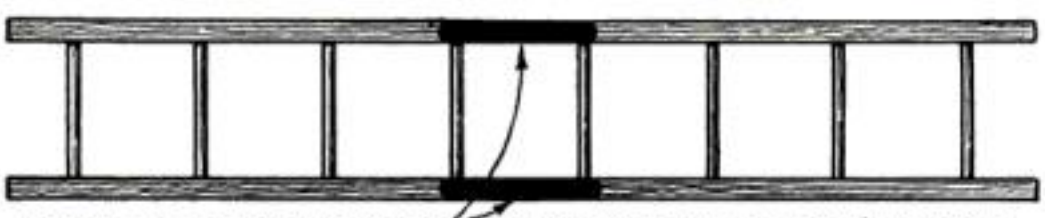
ARMATURES that have long, slender shafts with no centers can be mounted in the lathe for truing their commutators with the aid of a tailstock support of the type shown. This is turned from steel 1⅝" in diameter and 4⅜" long. A hole ⅞" in diameter is bored 1" deep in the large end to receive a brass bushing into which the armature shaft fits. A set of bushings may be made to hold shafts of from ¼" to ¾" diameter. Each should be 1 3/16" long and have a ⅛" transverse hole drilled through near enough to the end to clear the support. A piece of stiff steel wire is passed through to aid in removing a bushing. In use, a few drops of oil should be put on the shaft where it fits into the bushing. The accessory will also support long, thin rods, helping to keep them rigid so that they will not spring away from the cutting tool.—JOHN A. BATES.





Contrasting Paint on Ladder Marks Its Carrying Point

IN MANY types of repair, painting, and construction work, it is necessary for workmen to carry short ladders from place to place. It is important to pick up such a ladder at the point of balance, otherwise time is lost by having to stop to shift it on the shoulder. One solution is to paint a 12" section of the ladder at the point of balance in a contrasting color. A workman then automatically lifts and carries the ladder by this painted part every time.—ALBERT J. MCELFRESH.



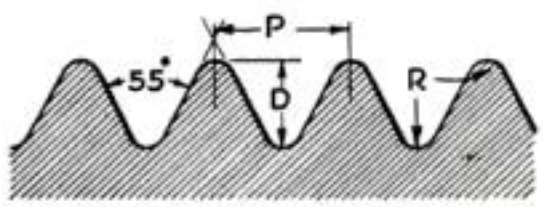
WHITWORTH AND METRIC THREADS

[LATHE WORK]

The Whitworth thread is standard in the British Isles for nearly all types of threads, the smaller sizes being designated as British Standard Fine. Whitworth threads are cut in much the same manner as Acme threads, with two major differences: the thread angle is smaller, and the radii at the top and bottom of the thread must be cut accurately with a formed tool.

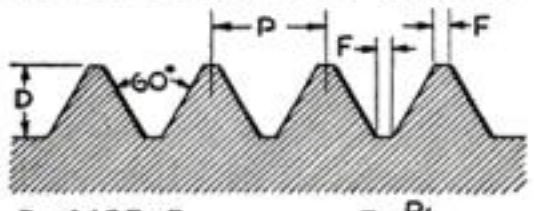
The International Standard Metric thread is standard in Europe and widely used on optical, scientific, and surgical instruments. Both the helix angle and the form are basically identical with those of the American National Form thread, but in practice the metric thread is usually given a radius at the bottom, the depth of which is sometimes specified as .0633 times the pitch in mm. Metric threads can be cut on a lathe having an English lead screw by means of compound transposing gears, but the lathe must be reversed after each cut because the metric threads have no relation to the threading dial.

Whitworth Form Thread



R=.1373×P D=.6403×P

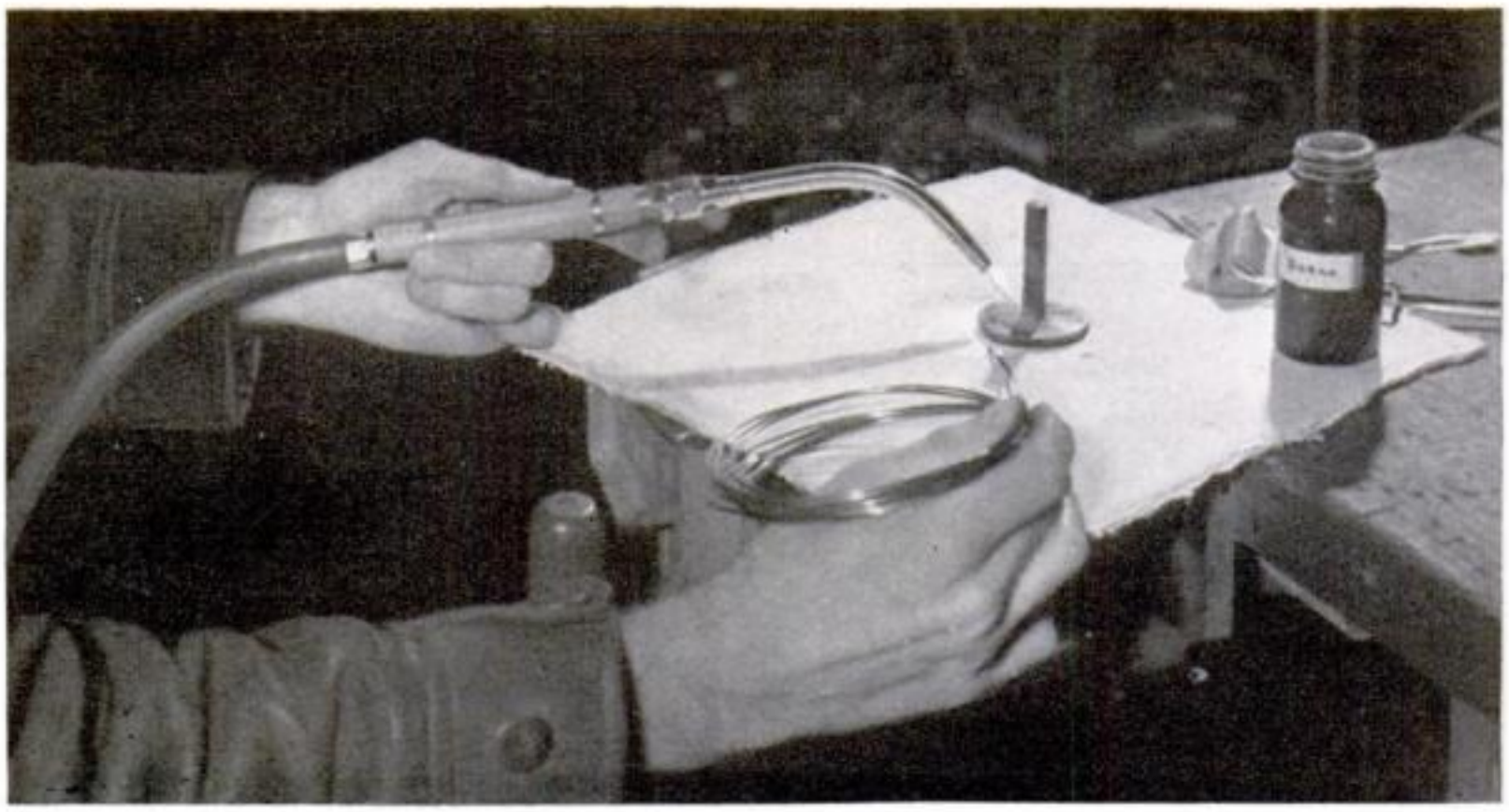
Metric Standard Thread



D=.6495×P F=P/8

P=PITCH IN MM.

POPULAR SCIENCE MONTHLY SHOP DATA



1

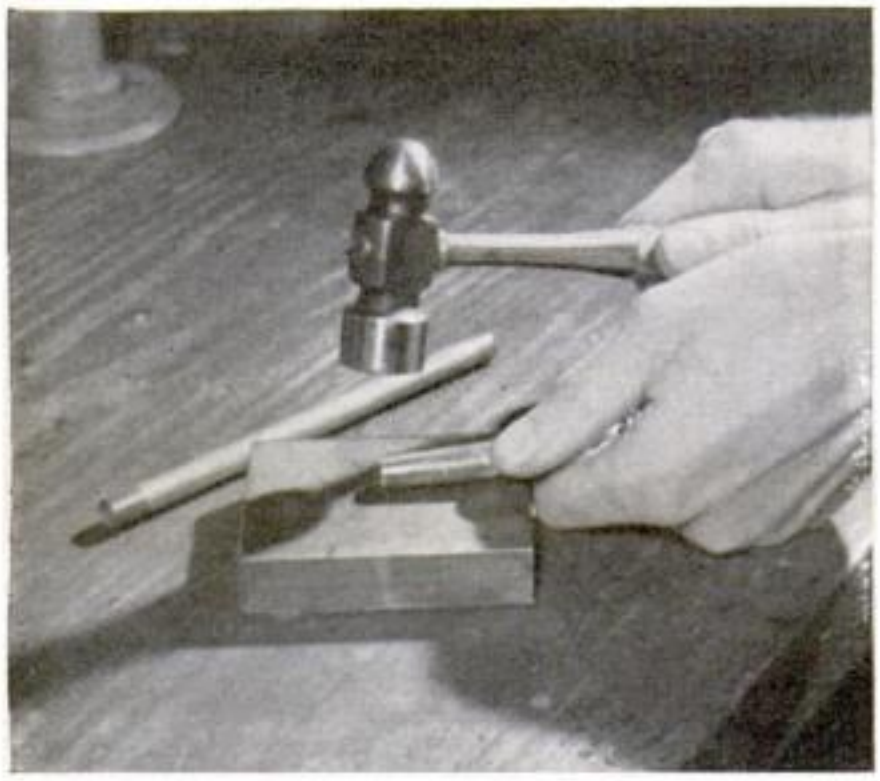
Acetylene Brazing Torch

REQUIRES NO OXYGEN

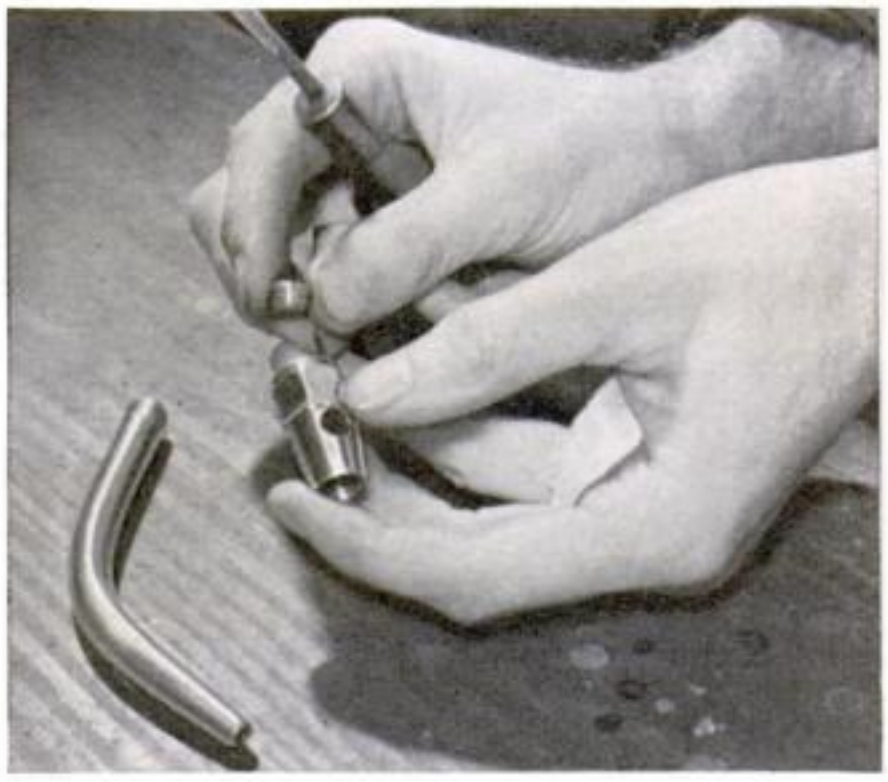
SOME of the uses you'll find for the acetylene-burning torch illustrated in Fig. 1 are melting aluminum and other metals, heating work that is to be bent, hardened, or tempered, and doing heavy soldering or light brazing. A small tank of acetylene gas will last the average home shop or small repair shop many months.

To make the handle, knurl a 4½" length of ⅜" brass pipe as shown in the drawings. Turn the trim bands, then square up and tap each end ½"-20. The end plugs are of ⅝" hexagon brass. A 1" section on one of these is turned down to 5/16" to form the hose nipple. This will make a tight fit in a ¼" hose. The other plug is threaded ½"-20 on both ends. Drill a 5/32" hole through each plug, coat the threads with oil-free gasket cement or shellac, and screw both plugs into the handle (Fig. 2).

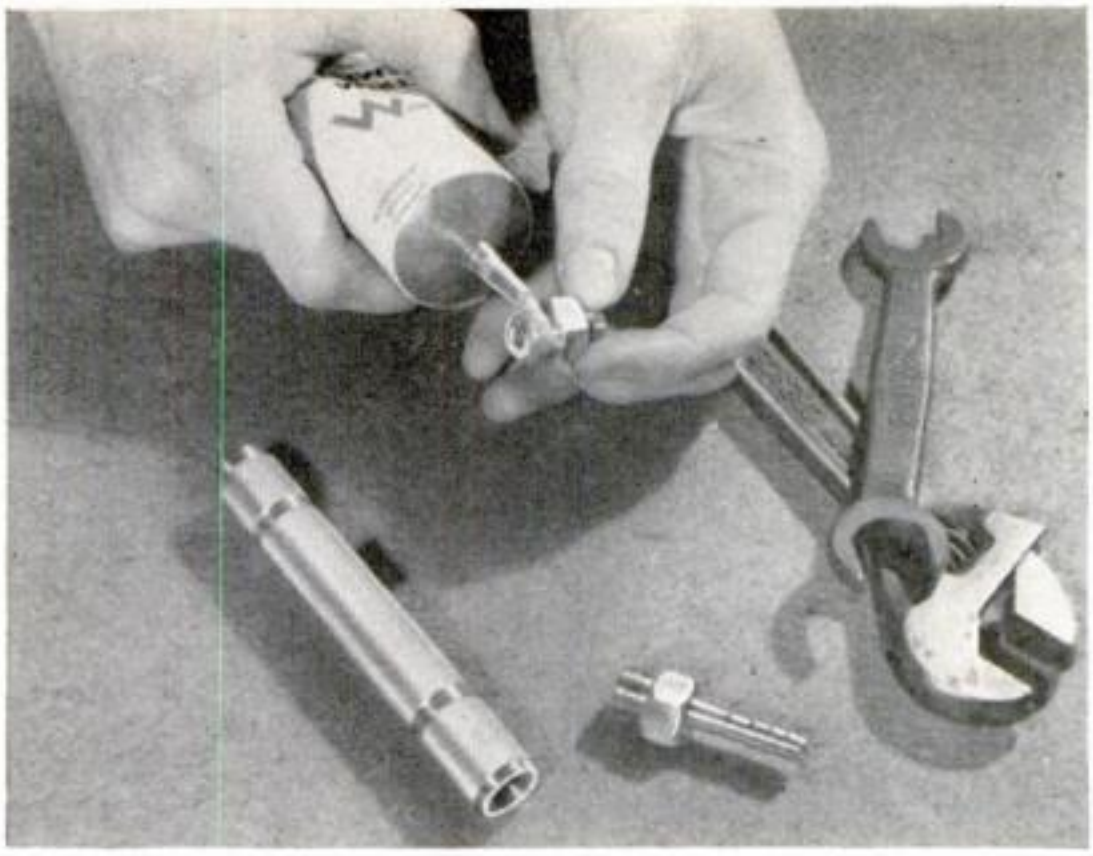
Draw down the unthreaded end of a 4½" length of ⅛" brass pipe by hammering it, as shown in Fig. 3, to 9/32" outside diameter for the tip. Turn the outside to a smooth taper, drill the orifice out to 5/32", and bend to the shape shown.



3 Draw down the unthreaded end of a length of ⅛" brass pipe by hammering to form the tip



4 Inserting the jet in the air mixer. When it is in place, the threads must be a gas-tight fit



2 Before screwing the end plugs into the handle, coat all threads with shellac or oil-free gasket cement in order to have joints permanently leakproof

The air mixer is made from a 5/16" by 1⅛" brass tubing connector, which has a ½"-20 thread to fit the handle plug. Drill out the throat to within ½" of the end with a "Q" or else a 21/64" drill, and the end ½" deep with an "R" or 11/32". Tap the throat two or three ⅜"-24 threads, and the end with a ⅛" pipe tap. Face the end off square for a good fit against the plug; then drill three evenly spaced 3/16" air holes into the tapered part, placing these so that the jet orifice will be just behind them. The mixer with the holes drilled is shown in Fig. 4.

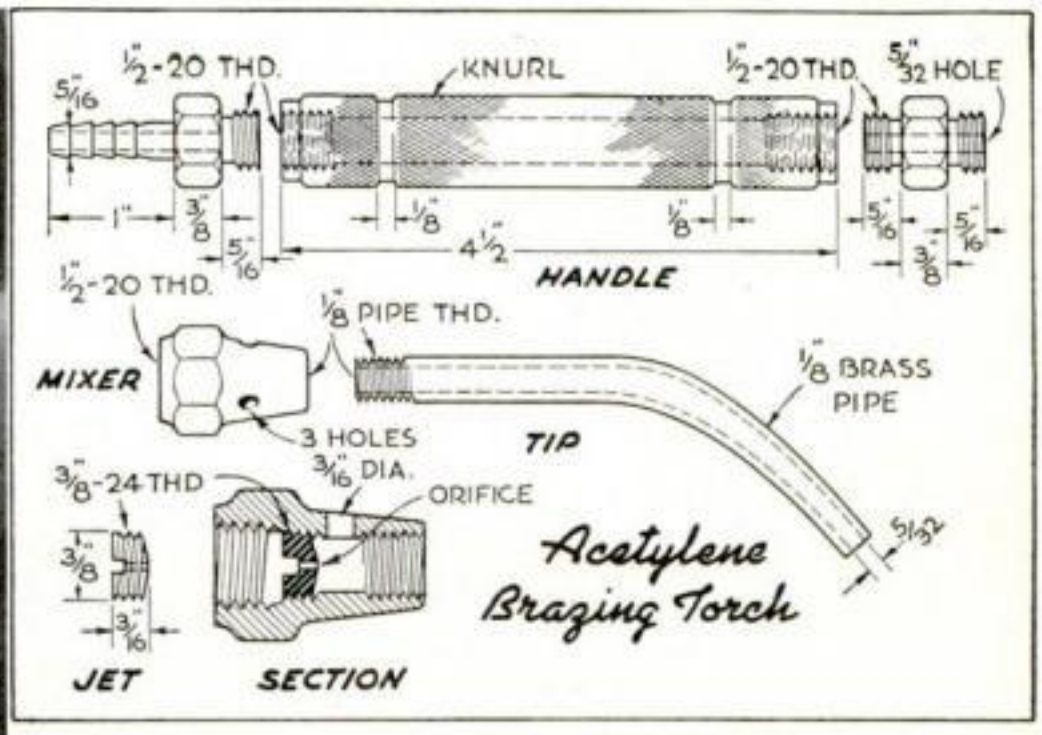
The jet has a slot so that it may be screwed into the mixer with a screw driver. Thread it back only far enough to bring the orifice where desired, so that the threads make a gastight fit. The orifice is the most critical part of the torch. It is nominally .010" in diameter, but must be made to suit the individual torch. If a drill of the right size is not available, use the smallest you have and tap the jet with a round-end punch to reduce the size of the hole. If the latter is thus made too small, it can be enlarged by driving a needle into it, as in Fig. 5.

The flame produced should be an almost invisible blue, with a sharp inner cone of light blue-green. This color will remain constant at all working pressures. Since it is quite likely that the torch will not burn just right when first tried, the following notes may be helpful in obtaining the correct mixture:

If the torch burns with a white or smoky flame, the jet is much too large. This results in low gas velocity, which fails to pull in sufficient air. Also, check for leaks anywhere between the gas source and the jet. If the flame pops back to the jet repeatedly when lit and refuses to burn at the tip, either the jet is too small or the tip orifice is too large. A blue flame with a white instead of a blue-green center indicates that the jet orifice is just a trifle too big.

While the tip shown will take care of most work, larger or smaller tips may be made to give flames of various shapes and characteristics for differing types of work. The tips can be changed instantly as required, provided no gasket cement is applied to the threads. The cost of operation will be found amazingly low.—W. A. CONWAY.

5 Should the orifice be made too small, enlarge it by driving a needle into it



Standard brass pipe and easily turned fittings are used as shown in the above drawing in the construction of this very useful little torch. It burns acetylene but requires no oxygen, and will be found adaptable to many purposes

HOMEMADE
Stirrup Pump
FOR FIGHTING INCENDIARY BOMBS

By Benjamin Nielsen

Built on accepted lines, a homemade stirrup pump such as that above is an efficient aid in combatting fires

WITNESSES of England's trial by fire agree that the humble "stirrup pump" used in that country to fight incendiary bombs has saved London. This portable hand-powered pump can be set into an ordinary bucket and switched from an empty to a full one almost instantly. It is held firm by placing one foot on a bracket or stirrup, hence its name.

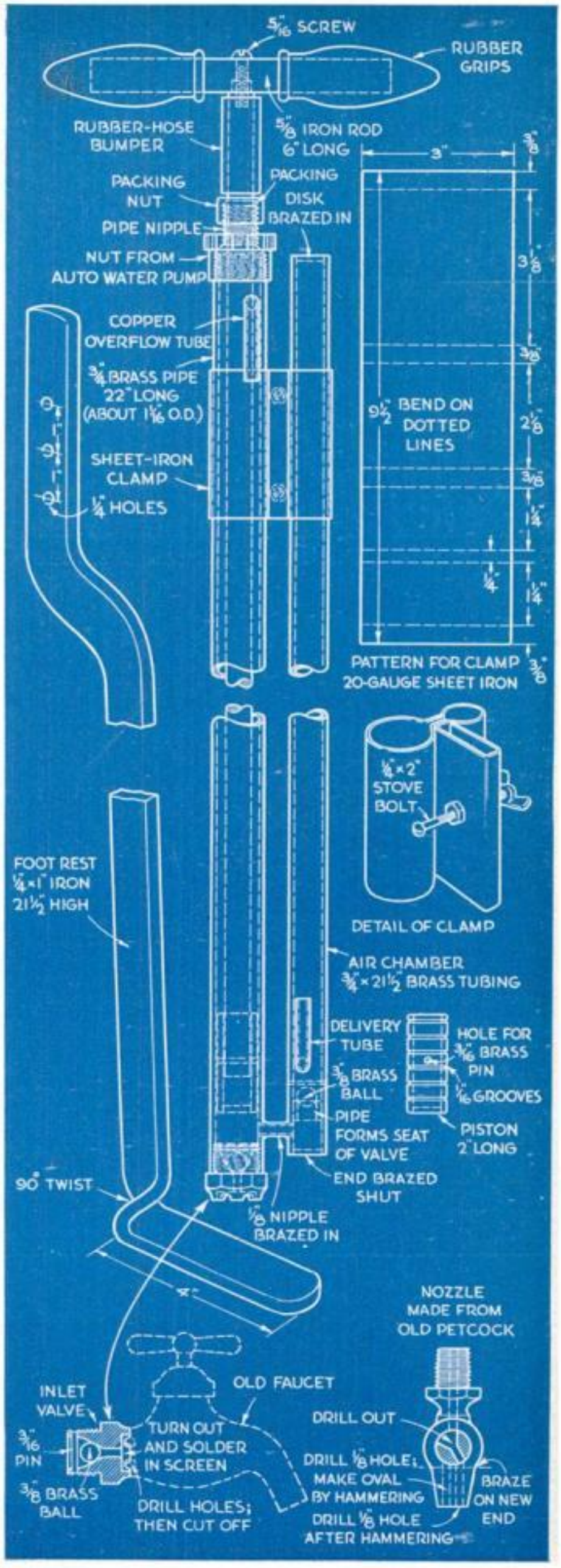
Any reasonably competent amateur metal worker can make a pump at moderate cost by the method to be described, and will find it a handy general fire extinguisher even if it is not needed during an air raid. It will throw a solid stream of water 30′ or a spray 15′.

For use on incendiary bombs, a spray is required, since water thrown from a bucket or turned on in a hard, solid stream, might cause the molten metal to scatter. Applied early enough, it will reduce the burning time from 10 or 15 minutes to 2 or 3. Because of heat, glare, and sparks from a bomb that has got fairly well started, the pump should be capable of throwing

Above, a commercial stirrup pump. Except for an outside air chamber to smooth the homemade pump's water flow, the designs are similar

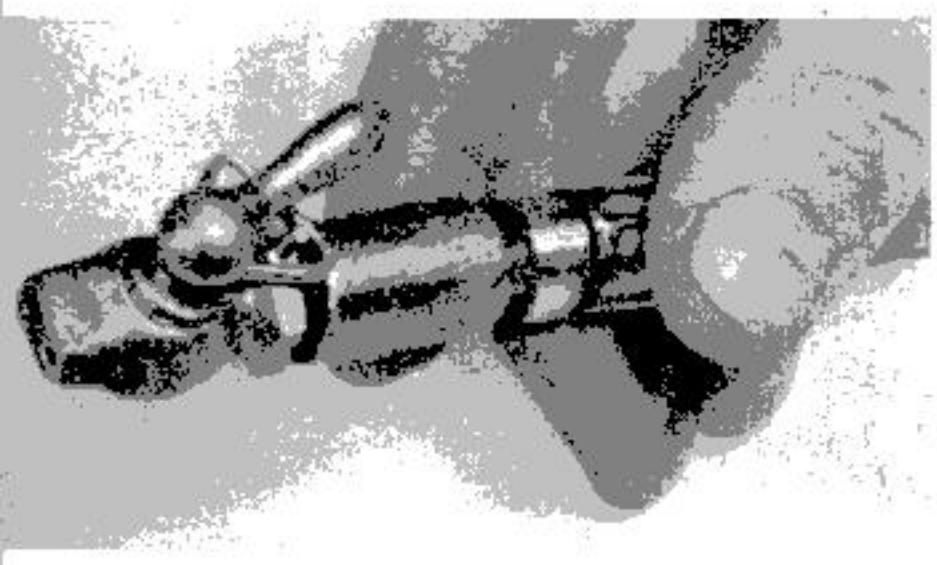
a stream 30′ and of delivering 2 gal. a minute through a ⅛″ nozzle. It should be equipped with about 30′ of hose (air hose such as is used at filling stations is excellent) and operated as near a water faucet as possible. One person handles the pump, another the hose, and a third can aid by refilling the buckets. As it takes about 6 gal. of water to extinguish a bomb and the fire it starts in its immediate vicinity, it is wise to have two 3-gal. buckets constantly filled and keep the pump near them.

All the parts of the homemade pump illustrated, with the exception of the handle bar, foot rest, and clamp, are of brass. Iron or steel parts are prone to rust and would make the pump undependable. An old tire pump having a brass barrel is excellent for the cylinder; if such a pump is not available, perhaps you can obtain a piece of ¾″ brass pipe (1 1/16″ outside diameter) from a house wrecker or a plumber. This should be 22″ long. Thread it at the top for a large packing nut taken from an old automobile water pump. Thread a short ½″ pipe nipple into the top of the packing nut, counterbore the pipe slightly to make space for packing, and fit with a nut drilled through for the brass plunger rod. Thread the bottom of the pump barrel inside to fit



Detailed drawing of the parts for a stirrup pump. Be sure to use brass for all metal sections that come in contact with water; iron or steel is likely to rust

At right, turned brass piston and lower end of the pump. The grooves seal against leakage. The discharge tube is at the upper left in the photo. Below, dual-jet nozzle with a triangle and pin to set valve for either spray or stream



the ¾" pipe threads on an old brass faucet.

Drill a ¼" hole near the top of the barrel and braze on the short overflow tube. Before doing any further work on the barrel, obtain a piece of new or used brass tube ¾" in diameter and about 21½" long for the air chamber, and make a clamp from sheet iron as shown in the drawings to fasten the barrel and air chamber together. Drill both of these near the lower ends for a short ⅛" pipe nipple, and assemble with the clamp. Braze the pipe nipple in place, and braze the delivery tube to the air chamber as shown.

A short piece of brass pipe turned to a press fit in the air chamber forms the seat for a ⅜" brass ball, which is held in by a retaining pin passed through the ¾" tube. Braze or solder over both ends of the pin to eliminate any possibility of leakage. Finally, plug the top and bottom ends of the tube with brass disks, brazed in.

To make the piston, a brass bushing is plugged at one end with a brazed-in disk and turned to a close but free-sliding fit in the barrel. Several narrow turned grooves form a simple but effective seal against leakage. The plunger rod in this case is a brass robe rail from an old automobile. It is attached to the piston with a 3/16" brass pin. To its upper end a handle consisting of a 6" length of ⅝" iron rod and two rubber handle grips from a tricycle is fastened with a 5/16" screw, the plunger rod being tapped to fit. A short piece of rubber hose forms an effective bumper.

The intake valve is made by drilling four holes into an old brass faucet as shown, then cutting off on the center line of these holes. Turn out the face of the short piece and solder in a piece of copper screening. The ⅜" brass ball and a retaining pin complete the valve, which is screwed into the end of the pump barrel.

A junked petcock forms the two-way nozzle. It is necessary to make the hole through the tapered plug wider on one side. The body is cut short and a solid piece of brass is brazed on. This is then drilled ⅛" to coincide with the plug hole. The hole is flattened by hammering to form the spray jet, and a second ⅛" hole is drilled beside it. Into the shank of the plug is brazed a triangular piece of stiff wire, which engages a stop pin in the valve body so that the plug cannot be turned beyond the two operating positions. A small pipe coupling is used to connect the hose.

The foot rest is made as shown in the drawings. The three holes in it permit adjustment to pails of different sizes.

POINTERS ON FIGHTING FIRE BOMBS

Three persons should work together if possible, one plying the hose, one the pump, and one filling pails.

Keep the pump away from the fire. It is wise to station it near a water tap if possible.

Crouch down and open the door of a burning room slowly. Keep your head away from the opening to avoid bursts of flame and fumes.

Crawl toward the fire bomb on hands and knees, head down, face shielded with one arm. Take cover behind a chair or table if you can.

If furniture or draperies are on fire, deal with them first by turning on a solid stream; then turn a fine spray on the fire bomb.

Set up for action, the case becomes a roomy typewriter table. Note that the lid serves as a seat

Collapsible Typewriter Table

FORMS CARRYING CASE

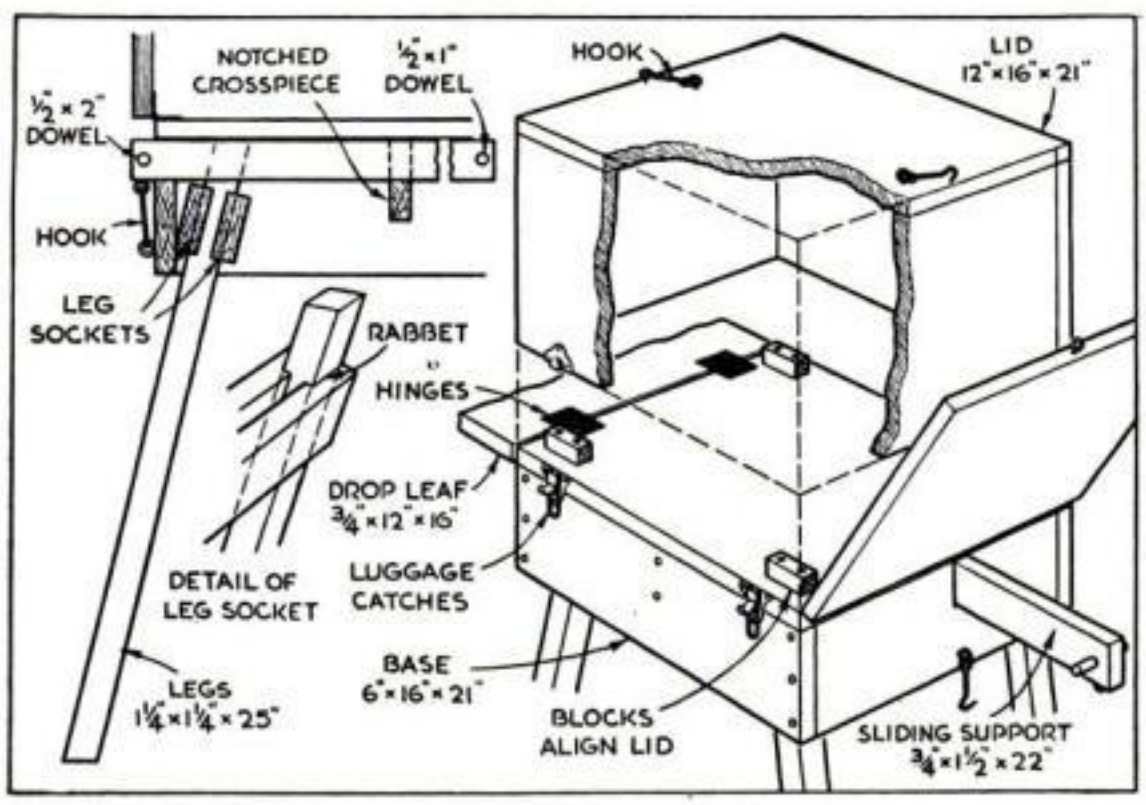
FOR field use of a standard large-size typewriter in connection with his military duties, Corporal Harry B. Young, of the 30th Field Artillery, U. S. Army, devised the combination case and table illustrated, which will serve as well for civilians on trips to the shore, country, or mountains. It can be set up in a few seconds. When packed, the case forms a compact unit and the legs are strapped together into a small bundle.

The two parts of the case are made of ¾" stock, with simple nailed butt joints. Four luggage catches secure the lid to the lower part, and two hooks hold the drop leaves up in the folded position. Both leaves are hinged to the top of the base section. The typewriter also is bolted fast to this part.

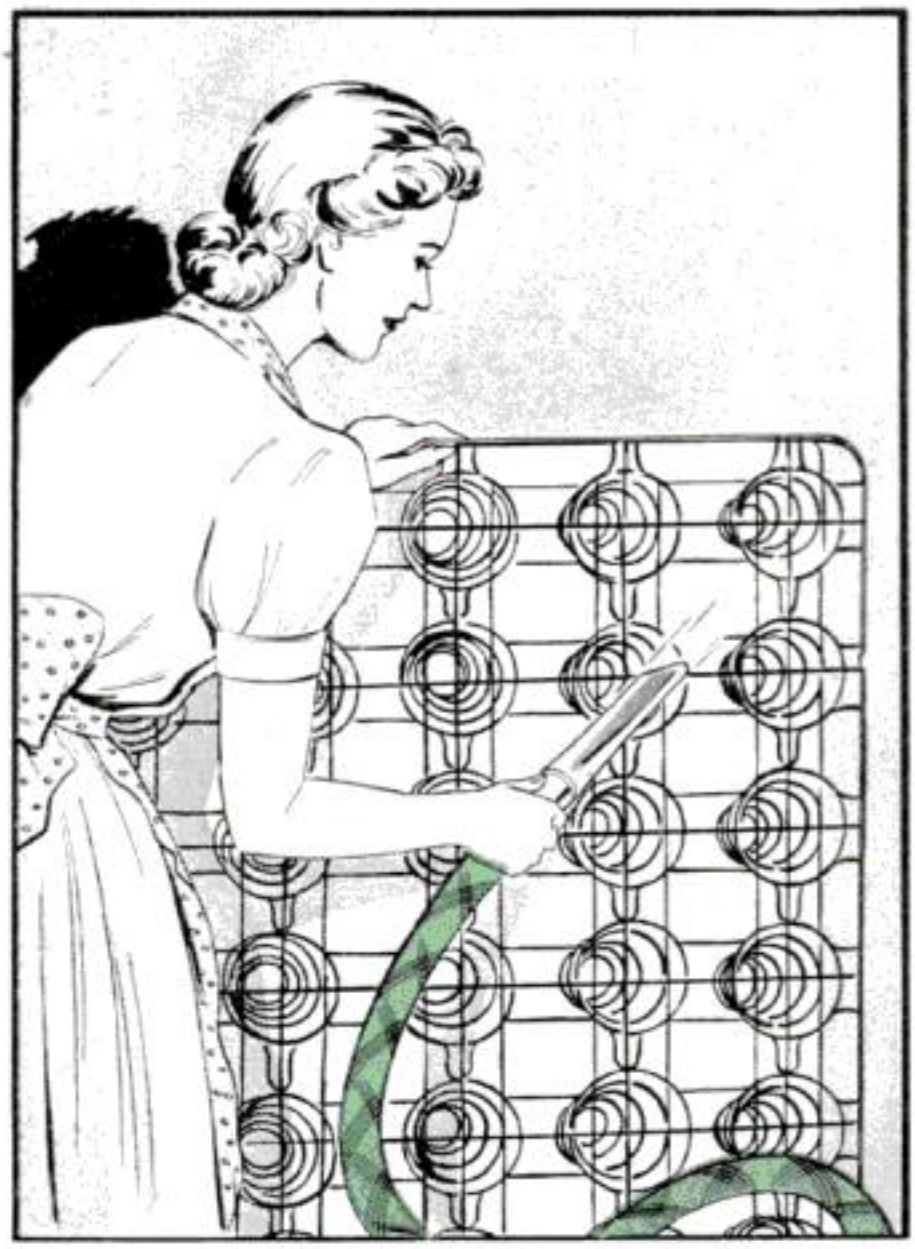
Sliding bars that pass through cut-out slots in the sides of the base support the drop leaves. Inside, these bars run in a notch in the middle crosspiece. They are offset on either side of the center so as to clear each other when pushed in.

The leg sockets are formed by rabbeting the ends of four crosspieces and nailing these in place at a slight angle as shown. Rope, luggage handles, or drawer pulls, if available, can be attached to make carrying easier.

Top to bottom, typewriter table in use and being packed to carry



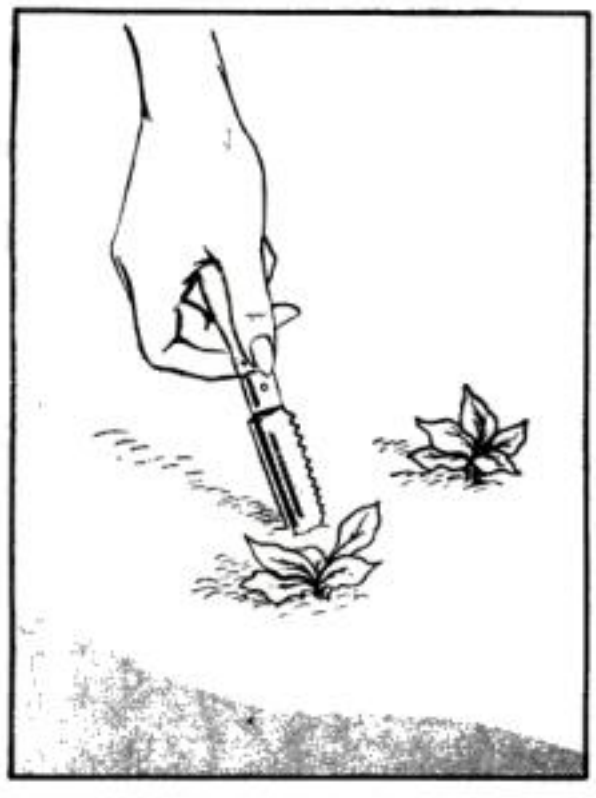
KEEPING THE HOME



Cleaning coil bed springs will prove a less irksome task if you pin a wet sheet to the underside of the springs and use the blower attachment of the vacuum cleaner to remove the dust, which will adhere to the damp sheet instead of scattering all around the room

The contents of vacuum bottles may be indicated by ½" or ¾" white elastic bands having names of the beverages lettered neatly on them. When a bottle is emptied, turn the band inside out

An antproof stand for a dog's or cat's food dish can be made of hardwood on any workshop lathe. Turn out a ½" by ⅝" groove near the outer edge and a recess to fit the bottom of the dish. Fill up the groove with salt water



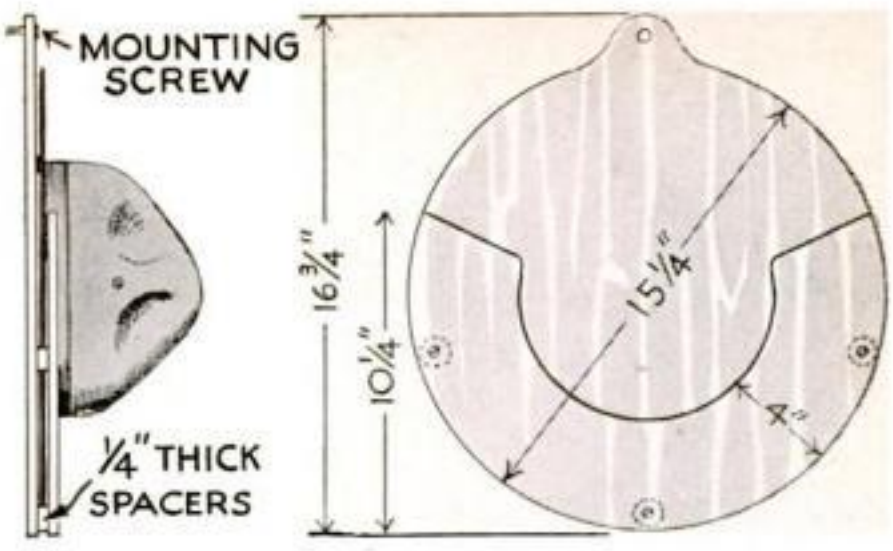
The use of an ordinary apple corer as a trowel when working around small plants will help to prevent injuring the tiny, delicate roots

A square of window screen placed over a stove burner when singeing a chicken will protect the hands and keep the stove burners clean

Fasten a pair of oval embroidery hoops in the top of a flour sack and slip over a wire coat hanger when in need of a clothespin bag

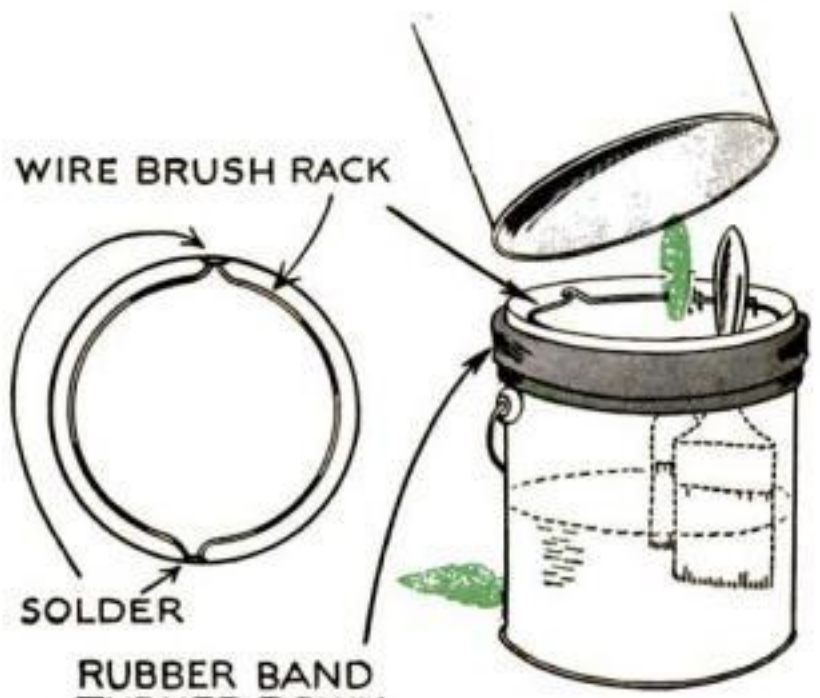
SHIPSHAPE

To make an emergency oil-stove wick from two old ones, remove both from the carriers, cut 1″ off the burnt end of one and trim the other to leave 1″ above carrier when both are put in

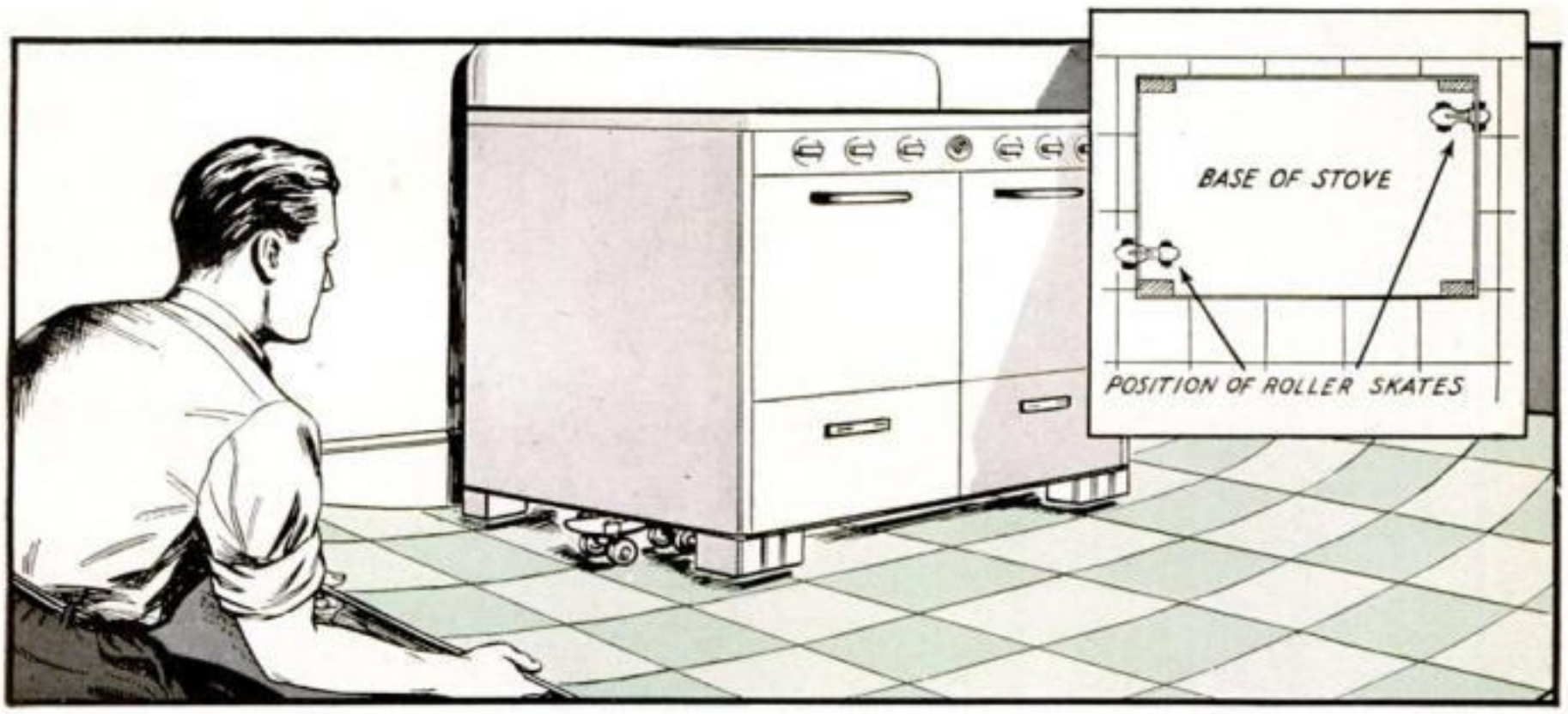


A convenient holder for large, flat-brimmed Boy Scout and similar hats can be made as shown from two pieces of ¼" scrap plywood spaced ¼" apart

Ordinary lighter fluid makes a very satisfactory substitute for the special thinner used to dilute rubber cement and keep it at brushing consistency



Fitting a wide rubber band cut from an inner tube around the juncture of the two tin cans makes this paintbrush container evaporation proof. To open it, peel down the rubber band



Two or four roller skates make it possible for one man to lay kitchen linoleum without disconnecting the gas range. Place them diagonally as shown if only two are used. If they are not high enough to lift the stove legs clear of the floor, put wooden blocks between the skates and the stove. Raise the latter only enough to get the linoleum under the skate wheels. It can then easily be pulled through

MODEL-RAILWAY NOTES:

Interlocking Signals

By DAVID MARSHALL

Author of Model Railroad Engineering

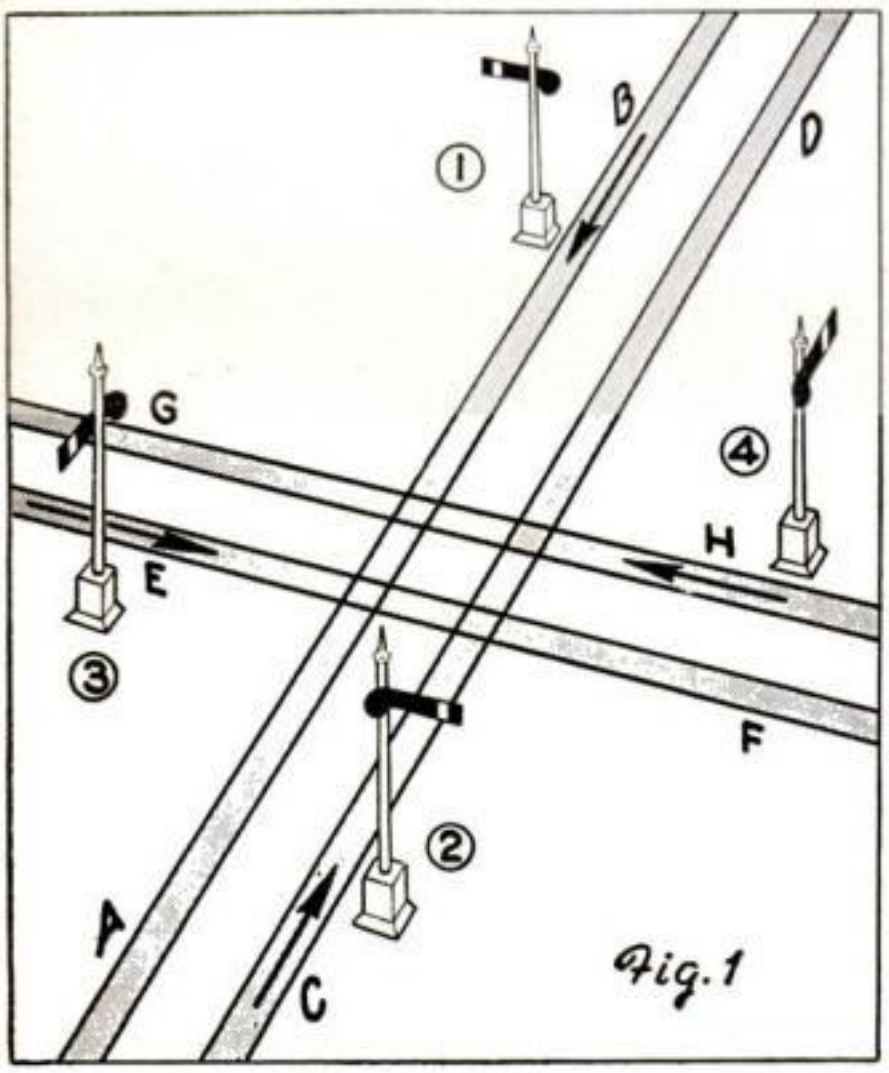


Fig. 1

WHERE two or more tracks cross, we have a problem in model-railway signaling—and one of the most fascinating in the whole field of signal engineering. Here, too, we are face to face with the subject of interlocking, which is simply a way of arranging **signals so that a single flow of electricity will do many things instead of just one. The double-track crossing is a splendid example of this.**

TRACK ARRANGEMENT. In Fig. 1 an east-and-west line, double tracked, crosses a north-and-south line, also double tracked. Our problem is to protect this crossing, and we begin by observing that four separate routes pass through it. It follows, then, that we shall need four signals, one to guard the entrance to each route. And so we list the routes and their corresponding signals as follows:

B to *A*, protected by Signal No. 1
C to *D*, protected by Signal No. 2
E to *F*, protected by Signal No. 3
H to *G*, protected by Signal No. 4

B to *A* and *C* to *D* are mutually acceptable; that is, trains may pass over both at the same time. *E* to *F* and *H* to *G* are likewise acceptable to each other. *B* to *A* and *E* to *F*, however, foul each other, and so does every other combination.

All these factors are translated into terms of signaling by observing that:

Signal 1 is in conflict with 3 and 4
Signal 2 also conflicts with 3 and 4
Signal 3 conflicts with 1 and 2
Signal 4 likewise conflicts with 1 and 2

Hence our problem is reduced to a simple matter of wiring together all four signals in such a way as to make it impossible for conflicting signals to go to the *clear* at the same time; that is, to interlock them.

INTERLOCKING SIGNALS. One hard and fast rule governs interlocking signals: An interlocking signal must normally, and without application of power, present the *stop* indication. It must go to *clear* only if power is applied, and revert to *stop* the moment power is withdrawn. Thus it must glow red normally, but flash to green the moment you energize the relay (Fig. 2), or, in the case of a semaphore, the blade must normally lie at the horizontal, and be drawn upward to *clear* by an energized magnet. Incidentally, the blade of an interlocking semaphore must have a square end and must be painted red with a white stripe.

Thus the problem is to *clear* each signal in such a way that those in conflict with it will be locked at the *stop*.

MANUAL MACHINE. It is unusual to operate by hand four signals already equipped with relays. We show such a system in Fig. 3 for the sake of simplicity. This can later on be developed into an automatic machine without sacrifice. The inert magnets representing our four signals are all at *stop*. The main lever is represented by a single-pole double-throw knife switch, and that for each of the four signals by a single-pole single-throw knife switch.

Tower routine requires that every lever be kept in the open position, except when a route is to be established through the crossing. Normally all signals are at *stop* and no train may pass through; in the language of signaling, there is no route. But when the towerman is notified that a train is in the advance block, approaching the crossing, he must create the correct route for that particular train. He does this in two moves: 1. He closes the main lever to the right or to the left, depending on whether the route is to run north-and-south or east-and-west. 2. He closes the signal level corresponding to the route he wishes to set up. Instantly, then, the signal rises to the *clear;* the route is "established."

This route is now automatically protected on both sides by two *stop* indications, which are frozen. The towerman is powerless to change either of these other two signals except by first canceling the route he has created, but he can create two routes acceptable to each other. Thus the machine protects trains even against human errors.

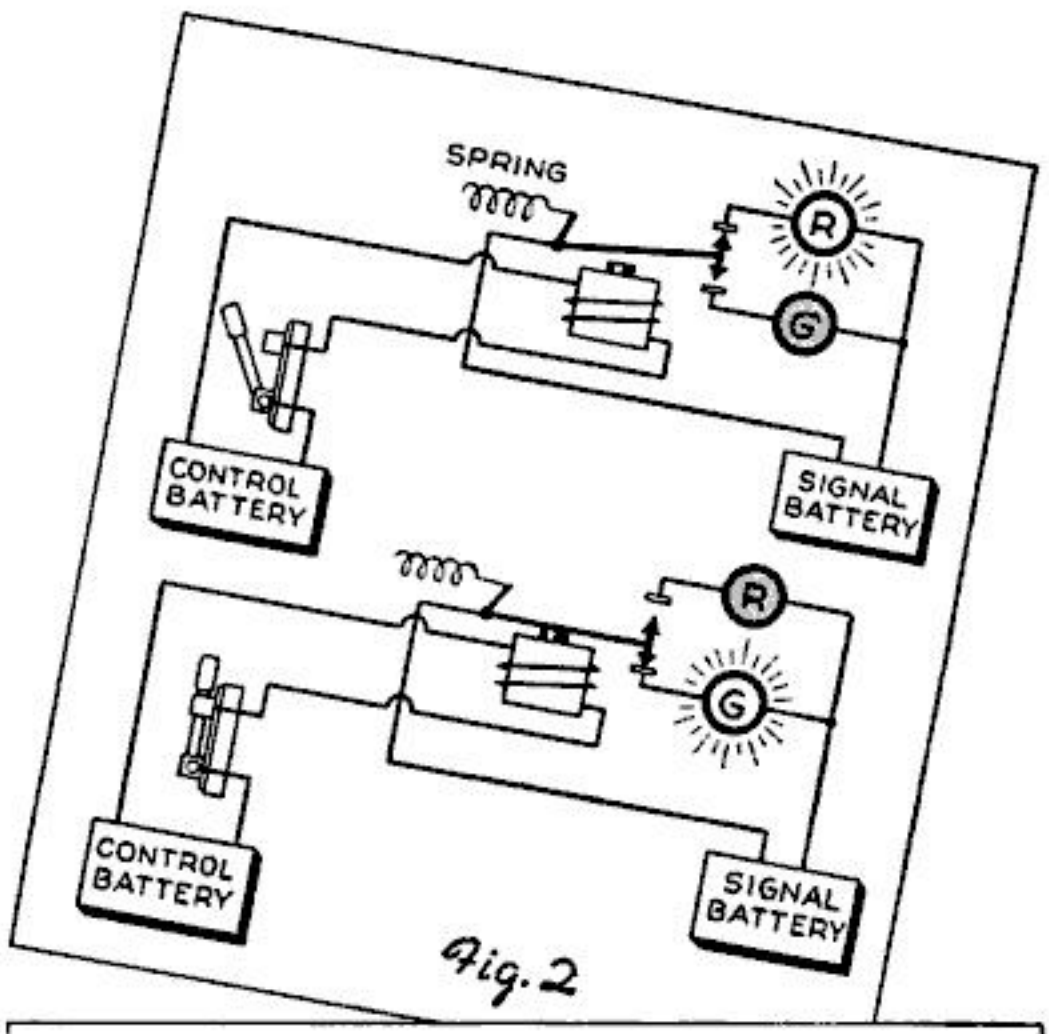


Fig. 2

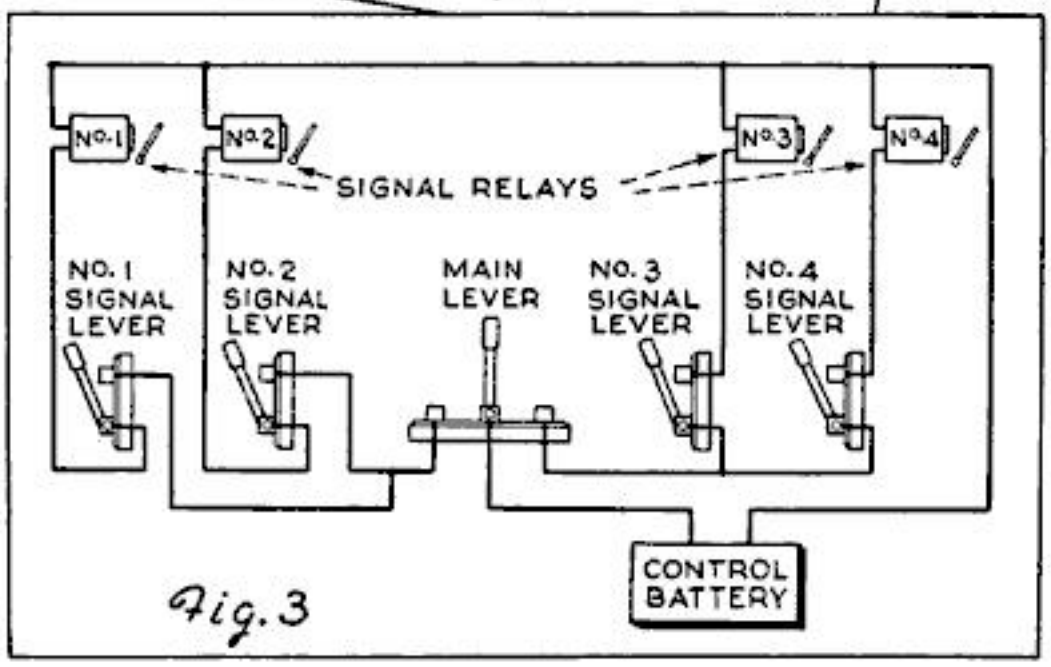


Fig. 3

Mats Made of Dowels Strike a Modern Decorative Note

This effective table mat is simply a number of dowels cut to length, drilled, and tied together

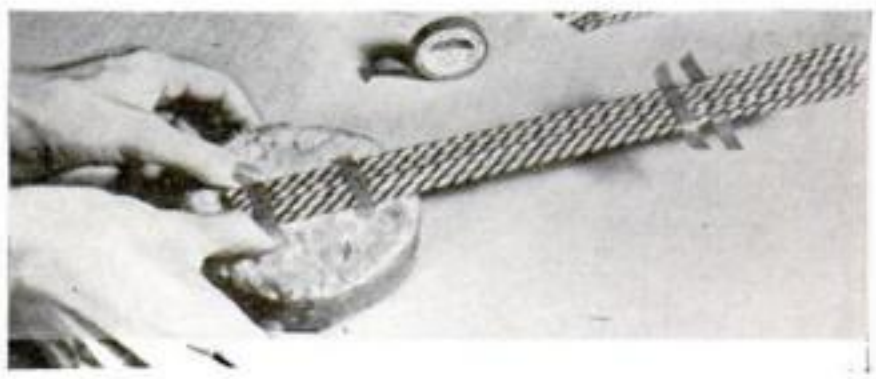
YOU can easily make distinctive luncheon place mats, hot-plate holders, and similar articles from ordinary dowels. Mats of this type give a novel modern effect under potted plants and flower bowls. A large one made of ½" dowels can be carried rolled up to picnics or beach parties. Unlike a cloth, it has enough weight of its own to lie flat on grass—and it can't blow away.

The flowerpot mat illustrated consists of 11" lengths of ¼" dowel. These are drilled through 1¼" from each end for the cord, which is a single length tied together alongside the last dowel. Use as many dowels as are necessary to make the size mat required—there are 52 pieces in the one shown. Decorative effects are possible by dipping the ends of the dowels in paint and arranging them in patterns, or by painting the entire mats.

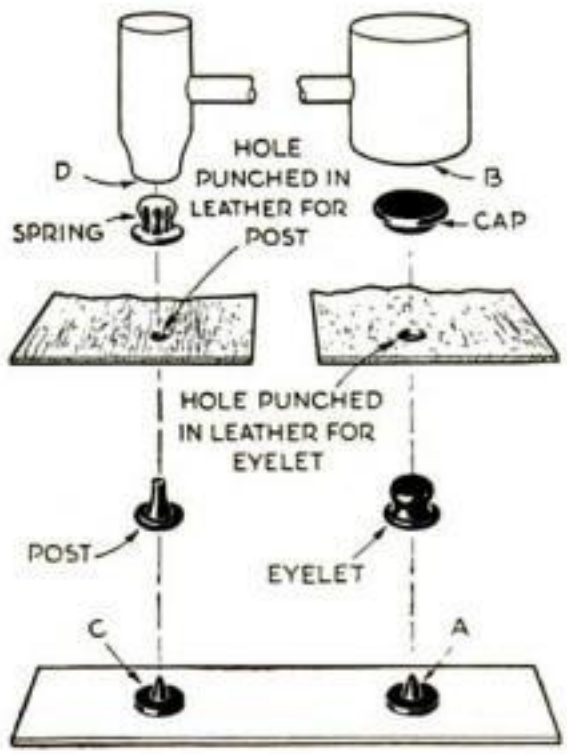
A drill press and a circular saw will speed the work. Use stop blocks on the machines to gauge the lengths and drill at the proper points.—J. O.

Drinking Straws and Cookies Form Banjo Party Favors

CHILDREN—and grownups too—will exclaim over these banjo party favors. Wrap two or three large cookies in clear cellulose film and apply decorative tape around the edge. Bright-colored drinking straws to match are then attached. Two pieces of tape near the end, one on top and one beneath, keep the straws aligned. A ribbon bow may be added.—B. N.



SETTING SNAP BUTTONS [*LEATHERCRAFT*]



To attach a snap button to leather, set the eyelet first. Locate the proper point for the eyelet and punch the correct size hole. Then place the eyelet over the anvil, *A* in the drawing, the leather over the eyelet, and the cap over both. Put the concave part of the special hammer, *B*, over the cap and eyelet, and strike sharply with a mallet, being careful not to use too much force, for that would cut the leather.

Locate the point for the post hole by aligning all parts and pressing the cap and eyelet firmly against the leather. Punch the correct size hole for the post at the place where the eyelet has left an impression. Next place the post over the anvil, *C*, the leather over the post, and the spring over the leather and post. Put the hollow part of the other end of the special hammer, *D*, over the spring, and strike with the mallet.

Tap the spring lightly if the button does not hold when snapped, or use pliers to compress the spring a little if it closes too tightly.

POPULAR SCIENCE MONTHLY SHOP DATA

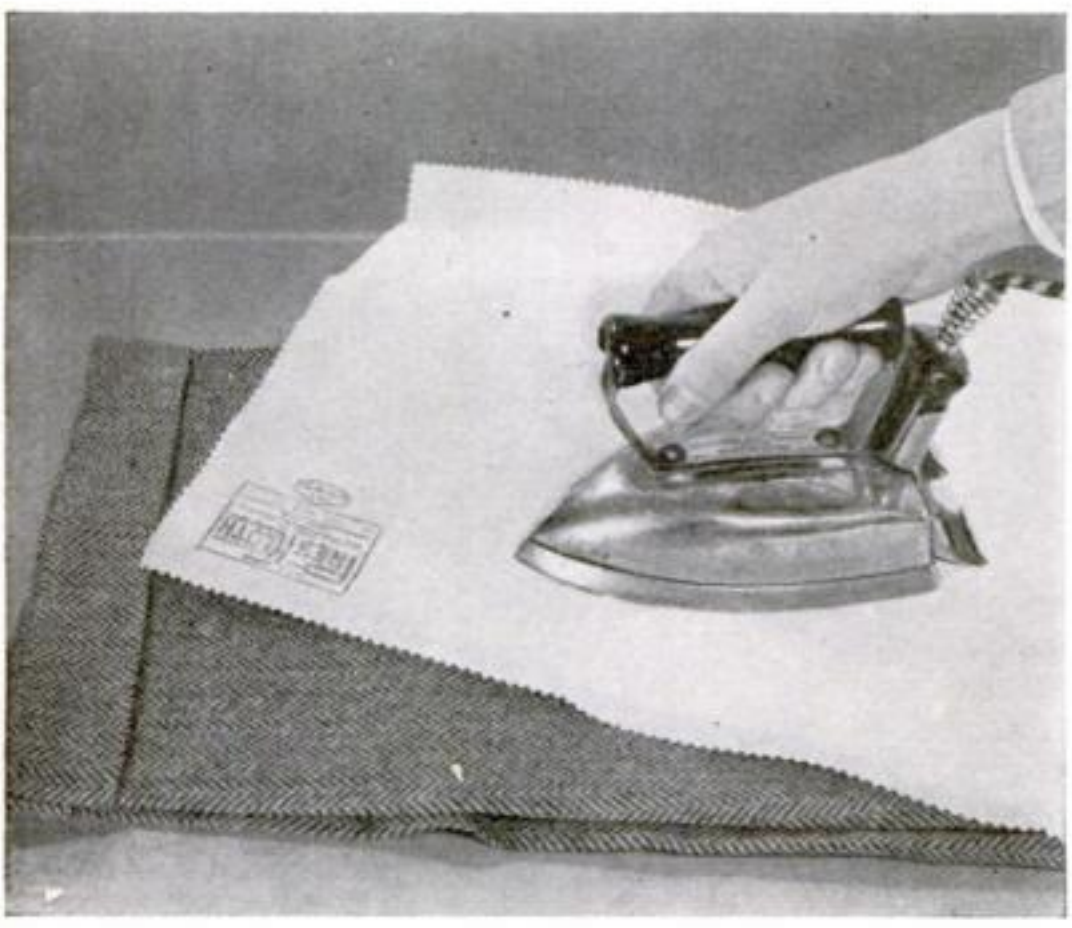
NEW APPLIANCES to aid in *Housekeeping*

TRAVELERS' COMPACT SUN LAMP

Built into a case small enough to slip into the pocket of an overcoat, this miniature sun lamp is designed especially for those who do much traveling. Businessmen who like to take daily health-ray treatments while on trips will find that it occupies little room in a brief case or in the corner of a suitcase. Storage is equally convenient in a small, modern apartment where space is at a premium. The streamlined metal case, 2¾" by 4⅞" by 9", is equipped with a bracket for hanging the lamp on a wall or elsewhere when it is in use. The finish is in ivory and chrome. The lamp will operate on either AC or DC power, and plugs into regulation household and hotel sockets. It is the result of a number of years of research to reduce the size and arrange the parts compactly

GLASS MATS FOR HOT PLATES

Table-surface protectors for use with hot dishes, tea- or coffeepots, vases, and flowerpots are now being made of clear, colorless glass which permits the finish of the wood to show through. These new accessories have the advantage of being easier to clean than woven and fiber mats, and their insulation properties are very efficient. Octagonal in shape, the mats are available in sets of four sizes ranging from 4" to 7" across. They may be obtained with monograms of three letters etched or hand engraved to order, and will be found attractive as personal gifts



STEAM-PRESS IRONING CLOTH

For use with any type of electric iron, this chemically treated cloth gives a steam press similar to a tailor's. It is simply laid on the garment and dampened lightly with a moist sponge before the heated iron is applied. Chemicals present in the special fabric turn the water into live steam, which is forced into the garment through small pores in the pressing cloth. The chemicals are said to last indefinitely. The cloth is recommended by the makers for pressing chiffon velvet, satin, silk, crepe, rayon, cotton, wool, worsted, and even heavy velvet when stubborn wrinkles are to be removed

Grinding

DO'S and DON'TS

WHEN Sam Sloppy forces a grinding wheel on an arbor too big for it, slips on a few assorted washers, clamps all tight with a 12" wrench, and steps up the speed of the wheel to make it grind faster, he's asking for an obituary. Playing nip and tuck with the fragments of a breaking wheel is highly dangerous; such particles may travel at speeds of a mile a minute and more. Yet grinding wheels are among the safest and most useful tools in the shop when not abused. It is necessary only to observe a few precautions to use abrasives for doing many jobs better and more quickly.

Some of the essential points are illustrated in the accompanying drawings, which appeared recently in "Grits and Grinds," a monthly technical publication of the Norton Company.

Choose the right wheel. Don't grind rough castings on a wheel intended for sharpening high-speed lathe bits, and don't try to sharpen tools on tough, coarse-grit wheels. Misuse can make wheels wear rapidly, and may burn or otherwise spoil work.

Handle wheels carefully. All grinding wheels are breakable. They should not be dropped, jarred, or carelessly handled. Before mounting any wheel, suspend it on a cord and tap it lightly with some small implement. It should give forth a clear metallic ring. If it doesn't, don't use it.

Use care in mounting a wheel. It should fit the arbor freely but not loosely. Never force a wheel on; expansion of the lead bushing may crack it. Use compression flanges—not common washers—on both sides. Clean flanges and arbors of all foreign material so that they do not bind at any one point. Tighten the nut firmly, but not so hard as to bend the flanges. Don't use loose bushings to make a wheel fit an arbor for which it is not intended.

After mounting a wheel, turn it by hand to make certain the spindle turns freely and the wheel clears guard and grinding rests. Be sure such attachments are tightly clamped in place. Only then turn on the power. Stand out of line for at least a minute before starting to grind. When you are using a portable machine, hold the wheel under a bench or inside a heavy casting for at least a minute.

Don't neglect common-sense precautions. It isn't clever or professional to grind without guards and goggles. Even a very small particle can cause serious damage to the eye. Adjust guards as the wheels wear down, to maintain maximum protection. Ties should not be worn in the shop. They are a definite hazard near whirling spindles or any other machinery.

DO

. . . Use the right wheel for each job. One too soft will wear rapidly; one too hard is slow cutting and needs dressing often

. . . Dress the wheel at the first sign of dulling. Be sure you use the right type of dresser; dress off no more of the wheel than is absolutely necessary

. . . Keep the wheel balanced on its sleeve. Unbalanced wheels wear rapidly, cause a poor finish, and are hard on the bearings

GRINDING-WHEEL SPEEDS [SHOP PRACTICE]

Wheel Diameter	SURFACE FEET PER MINUTE									
	4,000	4,500	5,000	5,500	6,000	6,500	7,500	8,500	9,000	9,500
	Revolutions per Minute									
1"	15,279	17,189	19,098	21,008	22,918	24,828	28,647	32,467	34,377	36,287
2"	7,639	8,594	9,549	10,504	11,459	12,414	14,328	16,238	17,188	18,143
3"	5,093	5,729	6,366	7,003	7,639	8,276	9,549	10,822	11,459	12,115
4"	3,820	4,297	4,775	5,252	5,729	6,207	7,162	8,116	8,595	9,072
5"	3,056	3,438	3,820	4,202	4,584	4,966	5,730	6,494	6,876	7,258
6"	2,546	2,865	3,183	3,501	3,820	4,138	4,775	5,411	5,729	6,048
7"	2,183	2,455	2,728	3,001	3,274	3,547	4,092	4,538	4,911	5,183
8"	1,910	2,148	2,387	2,626	2,865	3,103	3,580	4,058	4,297	4,535
10"	1,528	1,719	1,910	2,101	2,292	2,483	2,865	3,247	3,438	3,629
12"	1,273	1,432	1,591	1,751	1,910	2,069	2,386	2,705	2,864	3,023
14"	1,091	1,228	1,364	1,500	1,637	1,773	2,046	2,319	2,455	2,592
16"	955	1,074	1,194	1,313	1,432	1,552	1,791	2,029	2,149	2,268

POPULAR SCIENCE MONTHLY SHOP DATA

DON'T

. . . Use "any wheel" and risk waste. If in doubt on a job, go to your grinding-wheel supervisor or see the maker's representative

. . . Feed the wheel into the work faster than it can cut and invite a breakdown. Crowding a wheel will build up pressure and waste useful abrasive

. . . Leave wheels on the floor and increase breakage and surface dirt. After each is used, hang it up or place it in its rack

Run wheels at rated speeds. Next to using the right wheel, it is most important to use the proper speed. Never exceed that marked on the tag or label attached to the wheel. In general, vitrified and silicate wheels may be run at speeds as high as 6,500 surface feet per minute, rubber and resinoid wheels at up to 9,500, depending upon their grain and grade.

It is safe to increase the r.p.m. as wear decreases a wheel's diameter in order to maintain cutting efficiency, provided that the safe surface speed is not exceeded. Remember, however, to decrease the spindle speed when replacing a worn wheel with a new one.

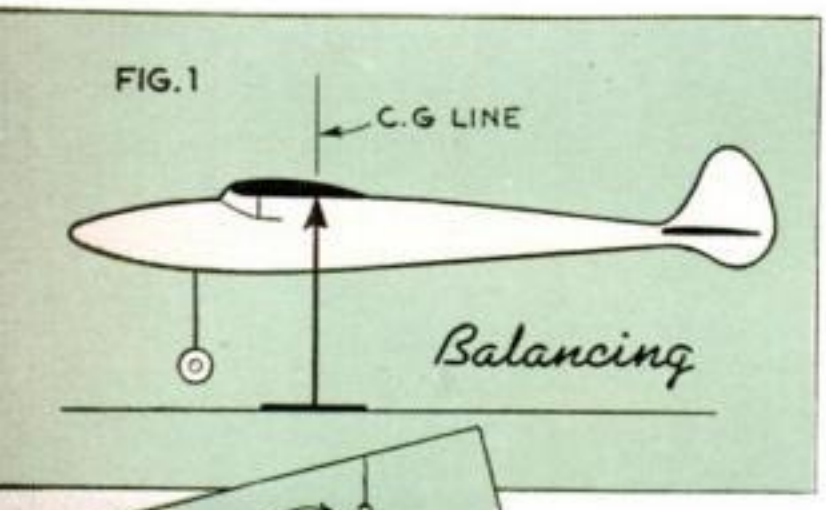
Avoid excessive pressures in using wheels. Feed work against a wheel lightly at first, until the wheel warms up, and always keep the pressure within reasonable limits, especially when grinding on the side. Too rapid or excessive heating may cause the wheel to break.

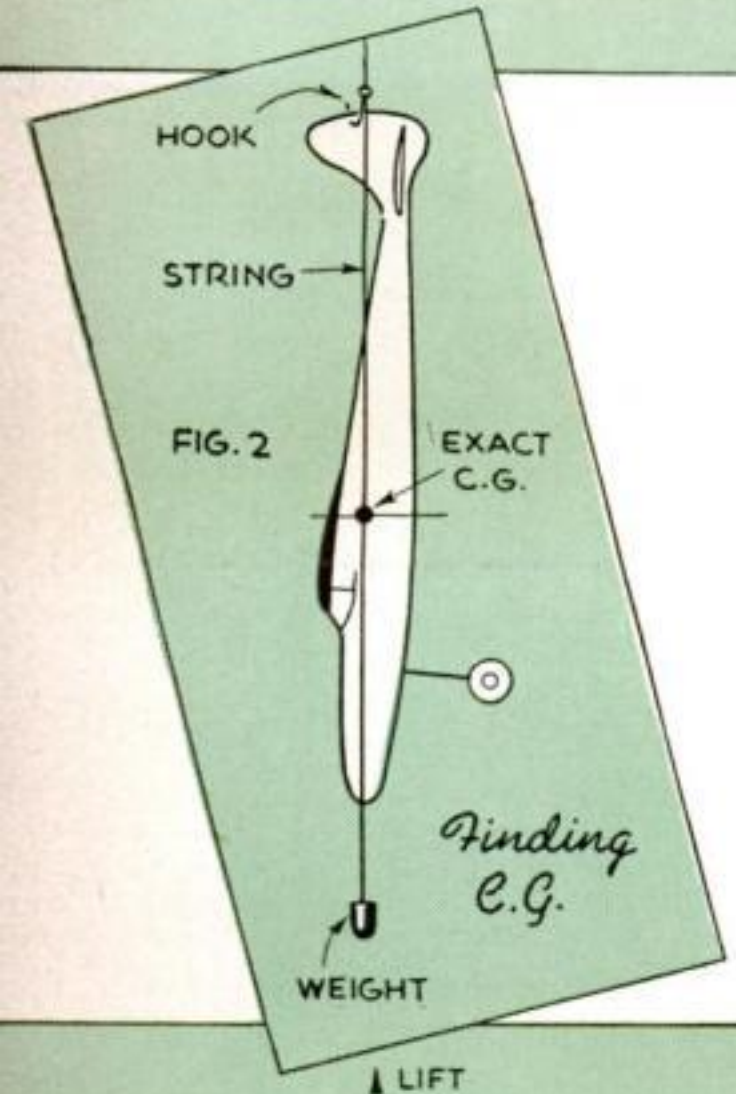
Use cut-off wheels only with the proper accessories. Abrasive cut-off wheels are usually run between 10,000 and 16,000 surface feet per minute. They can, however, be run at slower speeds with less efficiency and greater wheel wear. Use rubber-bonded or shellac-bonded wheels if it is important to keep the burr to a minimum; use resinoid-bonded wheels for long life. Whenever necessary, true them with a mechanical-type dresser.

Test Flying

MODEL AIRPLANES

By
Frank Zaic



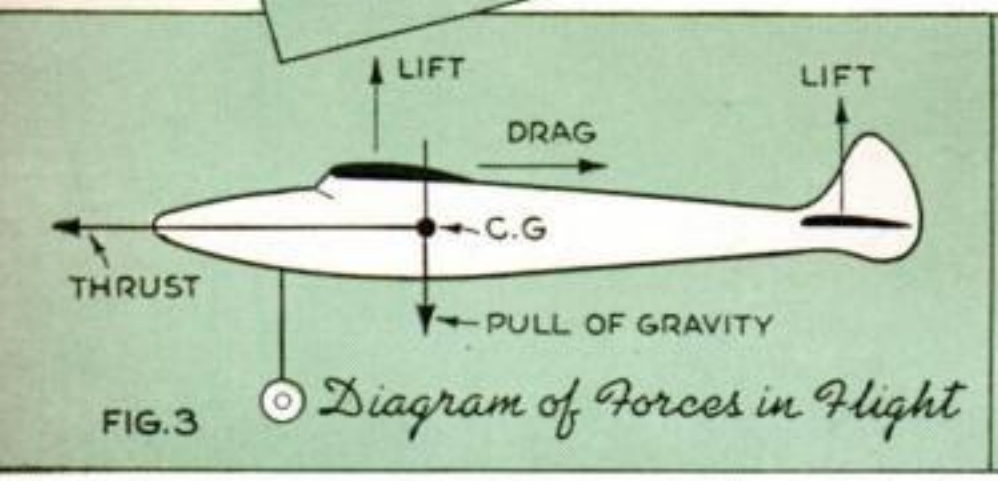


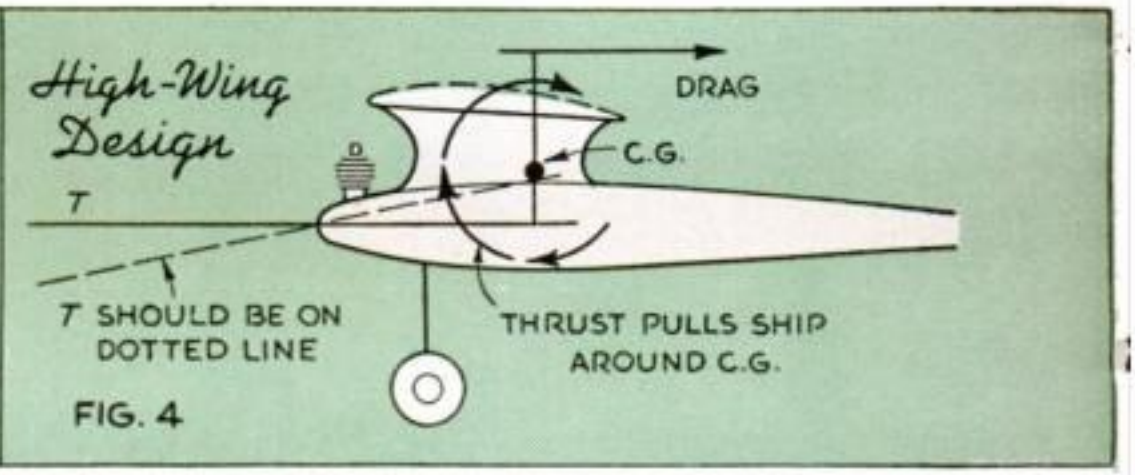
Checking model planes prevents costly crashes. Frank Zaic here demonstrates with a gas-powered model the second step in locating the center of gravity. The plane is suspended by the rudder from a wire hook that pierces the covering

MANY a model-airplane builder hopefully takes his creation on the field, winds it enthusiastically to the full, lets it go—and just a few seconds later has a splintered handful of balsa and tissue instead of a ship. Yet, provided that the model was well made and sufficiently powered, the disaster was probably avoidable. Checking and test flying would have revealed the faults that caused the crash, and these could have been corrected.

The seemingly erratic movements of an untested ship are not governed by chance, but by definite aerodynamic laws. Simply "seeing what she'll do" is the unscientific, haphazard way to try out a new plane. The right way is to learn what fault each bad flight characteristic indicates, and make adjustments accordingly.

An airplane must possess a combination of various stabilities, each doing its part to counteract the pull of gravity and at the same time keep the plane in flying trim. A model at rest and the same model in flight are two different things.





At rest, it develops no forces and is supported at three points, usually two wheels and a tail skid. When flying, it develops a number of forces and, so far as the all-important pull of gravity is concerned, it is supported at only one point. If we wish to suspend a model from a single cord in a level position, we must attach the cord either at or directly above the plane's center of gravity. The earth's pull will then be equal on all sides of the cord. The forces developed by the plane's lifting surfaces in flight must similarly balance themselves about this center of gravity if the plane is to fly properly, or, in other words, the plane must be aerodynamically stable.

To find the center of gravity, first balance the ship on both sides of the wing as illustrated in the drawing (Fig. 1), and mark on both sides of the fuselage the center-of-gravity line. Then suspend the model by the tail on a cord, which should extend past the nose of the ship and have a weight tied to it as shown in Fig. 2 and in the photograph on the facing page. Where the cord crosses the lines you have drawn—or, more exactly, at a point inside the fuselage between the two lines—is the center of gravity. A mark on the side of the fuselage, however, will suffice for test purposes.

Longitudinal stability is what keeps the model level in the fore-and-aft plane. Tending to upset it in this plane are the forces developed in flight (Fig. 3)—the lift of the wing and tail surfaces, the drag of the same surfaces, the pull of the propeller, and the drag of the fuselage, landing gear, and other projections. We can, however, disregard all but the lift and drag of the wing and tail, and the pull of the propeller.

When a model tends to loop or stall, it may be for any of several reasons. The wing may be too far ahead, or set at too great an angle of incidence. The stabilizer, on the other hand, may be at too small an angle. The corrections are to decrease the too powerful forces in front, or to increase those in back of the center of gravity.

If stalling or looping occurs during powered flight, but the model glides well, check the thrust line along which the pull of the propeller acts. If this line passes below the center of gravity, the pull tends to roll the ship around this point, causing it to nose up and loop (Fig. 4). The thrust line should always pass through the center of gravity; otherwise the plane will not fly well under power even though it glides perfectly. If it does glide well, do not change wing and tail adjustments, but only the thrust line. Slight alterations of the propeller thrust can be made by inserting small wedges between the fuselage and the nose block, and sometimes nothing more is necessary to make a "cranky" model perform beautifully.

The location of the center of gravity varies with the design. If the tail area is small, the center of gravity should be very close to the center of lift of the wing. This is particularly true of flying scale models, on which it is often necessary to add weight to the nose to bring the center of gravity forward. Contest and gas models, having big tail areas, may have the center of gravity almost at the trailing edge of the wing: Fig. 5 illustrates the gliding balance of such a model.

Spiral stability is necessary to keep the model level, and also to prevent it from rotating and going into a spiral dive. We must remember that the lift of a wing is *always* perpendicular to it. If the wing is tilted, as shown in Fig. 6, part of the lift is translated into a force tending to pull the model to one side. But now the plane is flying at an angle to its forward travel, as in the first diagram in Fig. 7. This in turn gives the inside wing a greater angle of attack; therefore it develops greater lift and automatically brings the plane back to a level keel. When the model is under power, the propeller torque constantly tends to rotate it and pull one wing down. But again the wing develops the side skid we have traced and neutralizes this new force, so that the dihedral angle actually counteracts the propeller torque.

Trouble develops, however, when surfaces are not properly balanced fore and aft of the center of gravity; most commonly, the rudder is too large. Such a rudder always tends to keep the model parallel to the air-

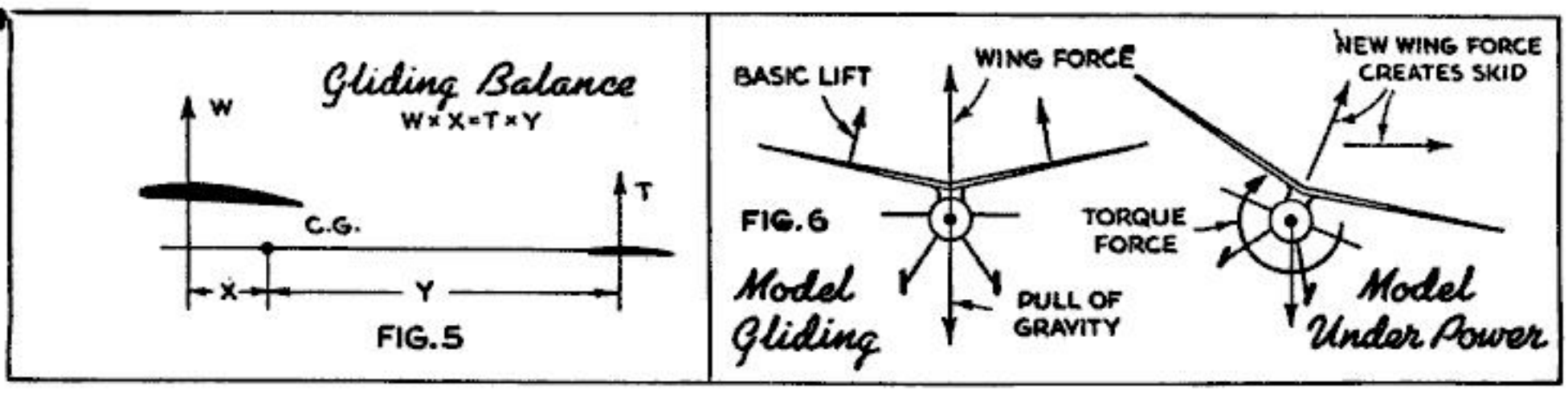


FIG. 5

FIG. 6

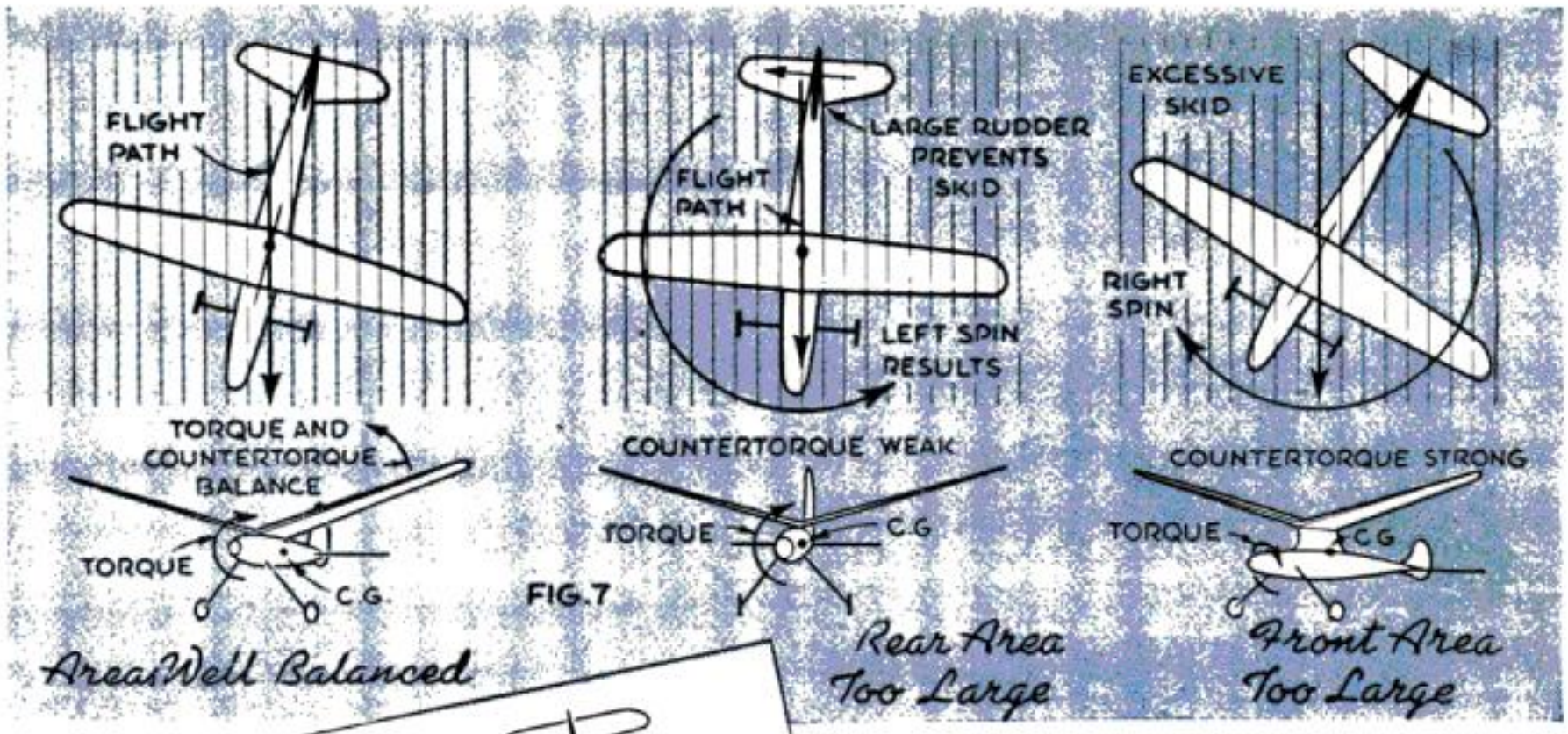
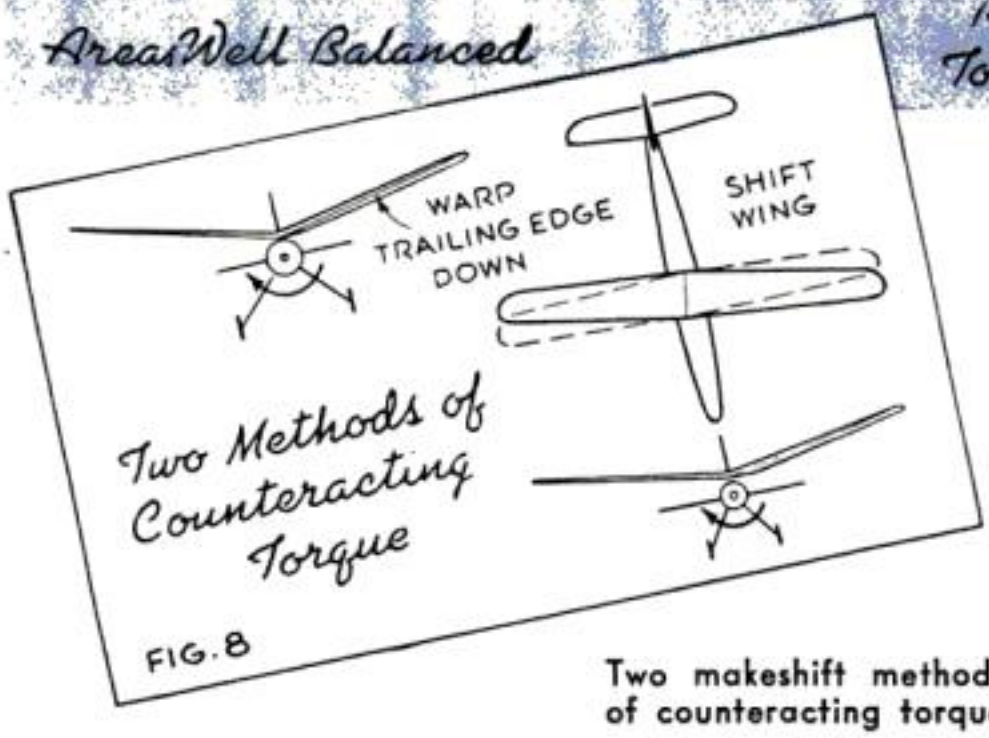


FIG. 7

The above diagrams show how side skid acts to counteract propeller torque, and what happens when either rudder or frontal area is too big



Two makeshift methods of counteracting torque

flow, as is also shown in Fig. 7. As there is no side skid, the dihedral fails to control the torque, which rotates the plane until the wing lift is no longer vertical, when the plane promptly goes into a left spin or a spiral dive. The cure, of course, is to decrease the rudder area to permit the necessary side skid. If the dihedral angle is small, increasing it will help because the model will not have to assume as high a side-drift angle before control is attained. Offsetting the propeller to produce a slight right thrust also may help to counteract too large a rudder. A makeshift adjustment consists of either warping the wing or setting it at an angle as in Fig. 8. However, the model is then no longer perfectly adjusted for gliding.

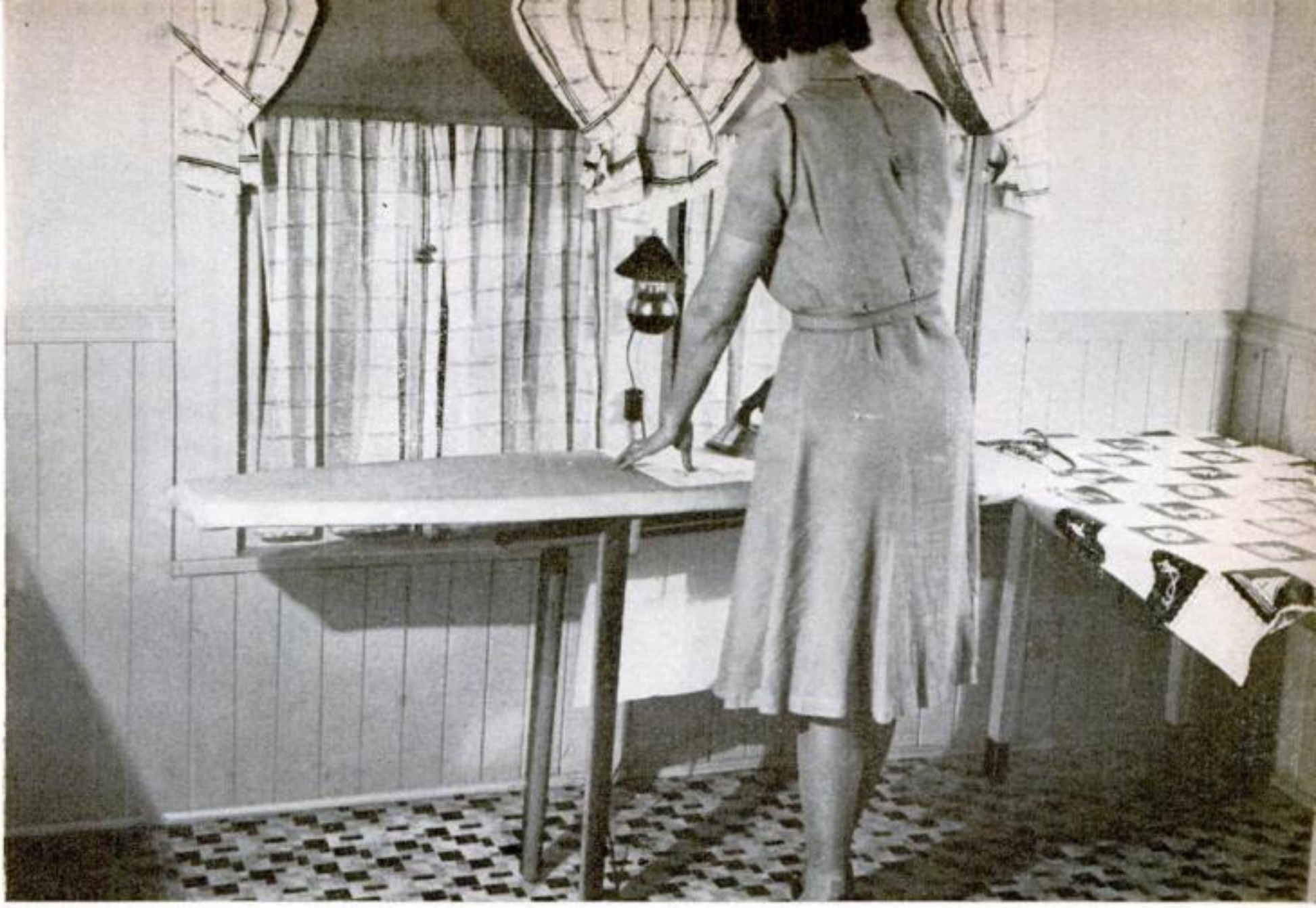
A right spin usually results from having too much area in front of the center of gravity. This tends to exaggerate the skid and create more lift on the right wing than is necessary to offset the torque. Especially with high wings, and a high center of gravity, this characteristic results in a right spiral climb (Fig. 7). Adjustments must be carefully made. If the right spin is eliminated by increasing the size of the rudder, the model may develop a tendency to loop, which must be counteracted by adding downthrust to the propeller.

The tendency to spin is most evident when a model is under full power. Under low power, the left spin will develop into a dive. But the right spin will tend to make the model stall; then the tail will wig-wag, indicating that it has not enough area.

Check a new model for longitudinal stability first by gliding it. When the glide is satisfactory, wind the motor only part way, or throttle down a gas model, and watch for any tendency to skid. If the turn is to the left, you may be sure that the rudder is too large or the dihedral angle too small. If the turn is to the right, the opposite condition prevails. If the model tends to climb into a stall, the thrust line is too low. Make the necessary adjustments before flying the model under greater power. It is well to remember that the center of gravity is usually higher than one would expect, or, better still, to locate it accurately by the suspension method described.

The tests outlined apply only to models that are well built and are basically sound. A model that has warps or other faults of construction cannot be tested properly until such basic defects are corrected, for they will introduce all sorts of almost unpredictable forces. Check wing and tail surfaces to see that they are not warped, and check them again on the plane to make certain that they are aligned with one another.

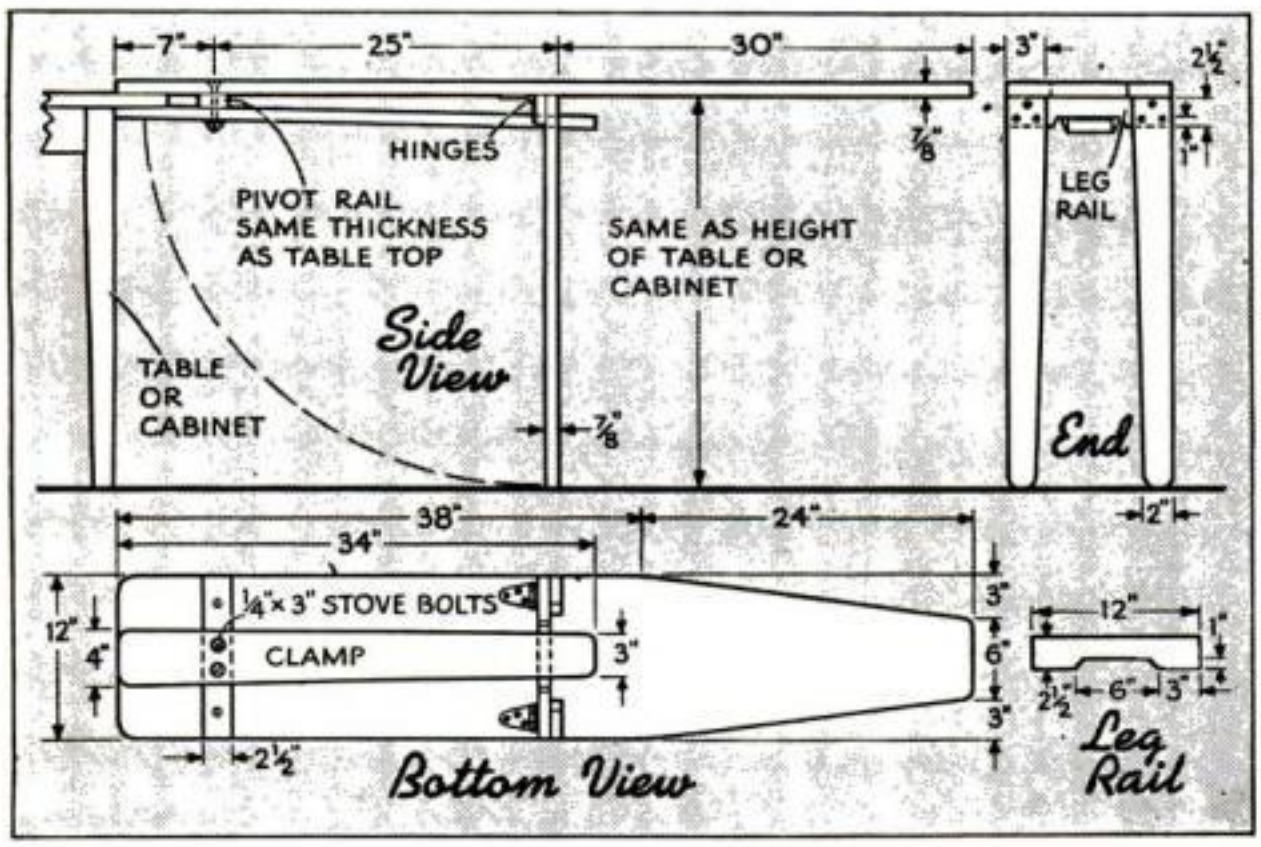
A sometimes unsuspected cause of trouble is a faulty freewheeling device that drags on the shaft. This may make the propeller act as a rudder when the motor run is over.



Ironing Board CLAMPS FIRMLY TO TABLE OR CABINET

RIGIDITY, which is essential in an ironing board, is assured by the design of the homemade board illustrated. It clamps automatically to the top of a table or cabinet by dropping the hinged legs. Half of the board is free for use without interference of braces.

Cut out the board, legs, and rails as shown. Note how the leg rail is notched. The pivot rail must be exactly the same thickness as the table top. Screw it to the underside of the board. Fasten the legs to the leg rail with screws, and attach the hinges. Turn the board upside down and place the leg assembly in its folded position. Set the clamp in position and drill two ¼" holes through the clamp, pivot rail, and board. Insert and tighten the ¼" by 3" stove bolts. Then raise the legs and fasten the hinges to the board.



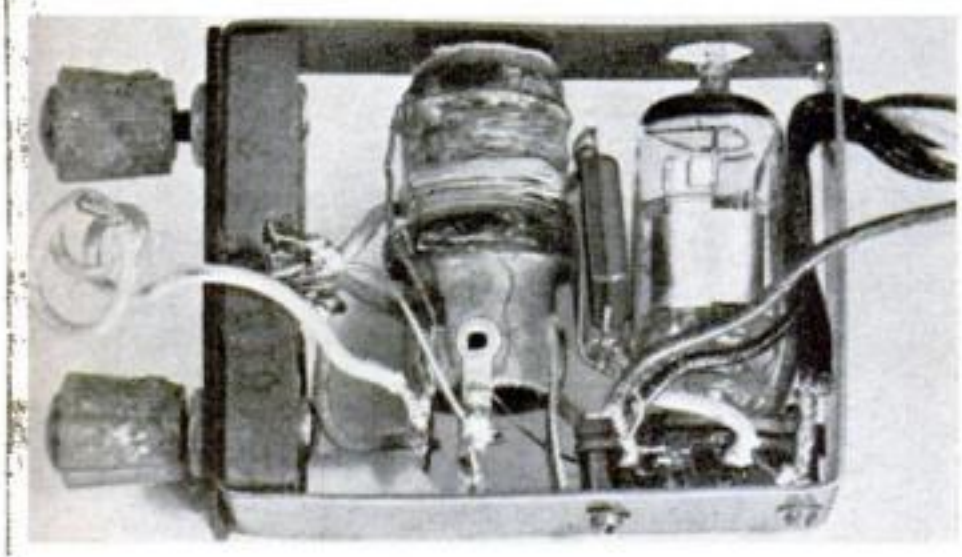
One or two sheets of asbestos paper will make an excellent ironing pad, and they also will protect the board from the heat. The usual covering is finally tacked or tied on.—EDWARD T. DAHLIN.

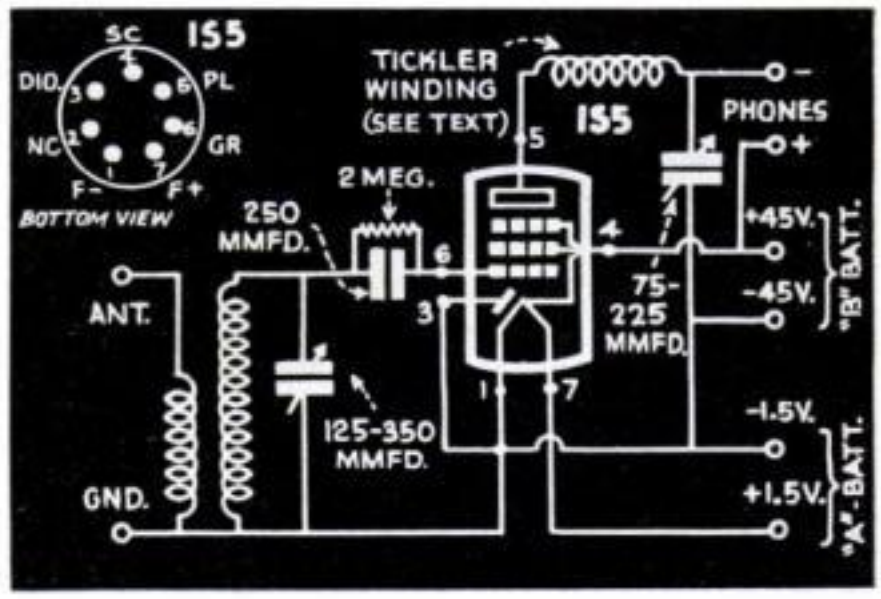
Hardwood is needed for legs, clamp, and rails, but pine serves for the ironing-board top. Leg dimensions vary with the height of the table

Vest-Pocket Receiver

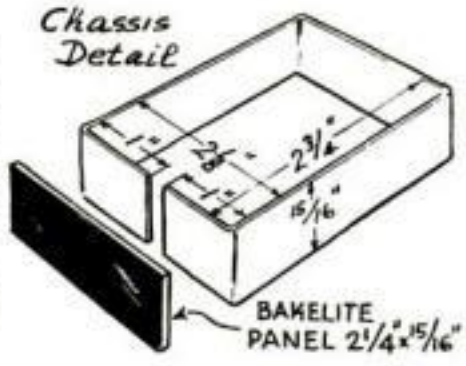
Really small enough to fit into the vest pocket

BUILT into a simulated-leather playing-card case, this one-tube receiver is powerful enough to get distant stations. The tube is the new all-glass 45-volt miniature diode pentode (1S5) with the unused diode portion grounded directly to the chassis or "A" minus. A "vest pocket" 45-volt "B" battery should last three or four months and an ordinary flashlight "A" battery will give several hours of use. Padder (compression) condensers less than 1" square are used, one for tuning and one for regeneration. They tune only about half the broadcast band, so the capacity most desirable should be decided before purchasing. An unshielded antenna coil, to which a tickler winding may be added by winding 15 to 20 turns of No. 30 d.c.c. wire to the lower portion of the grid winding, is satisfactory. Oscillation may be reduced by decreasing the turns or stepped up by reversing the connections to the tickler coil. No ground is used. The aerial is 20′ or 30′ of loose insulated wire.

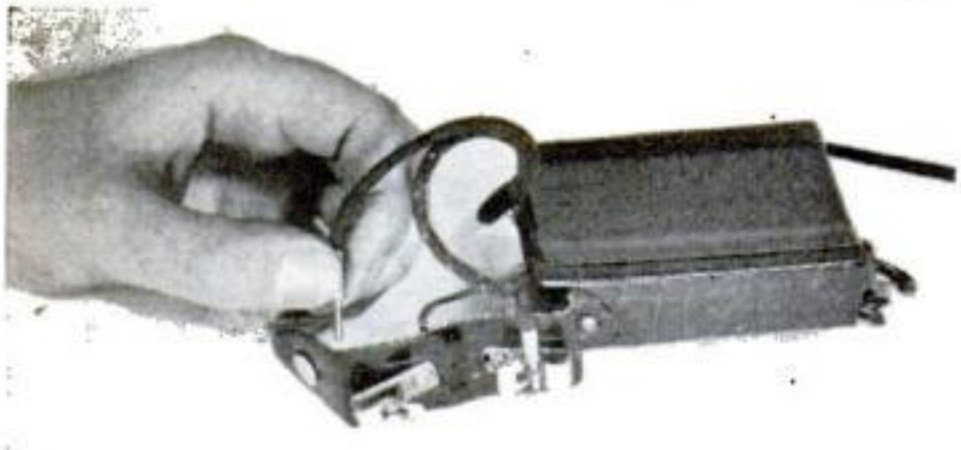


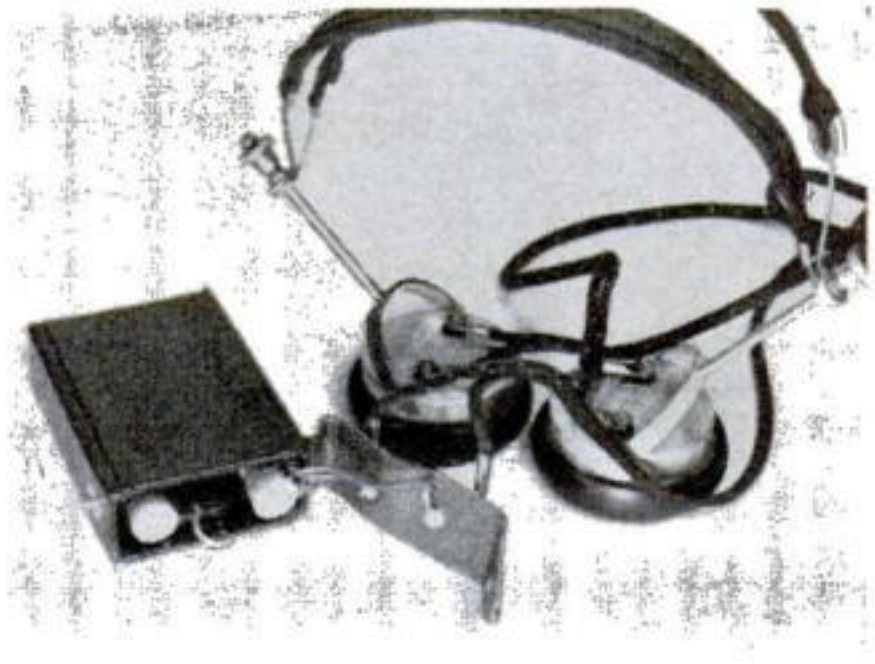


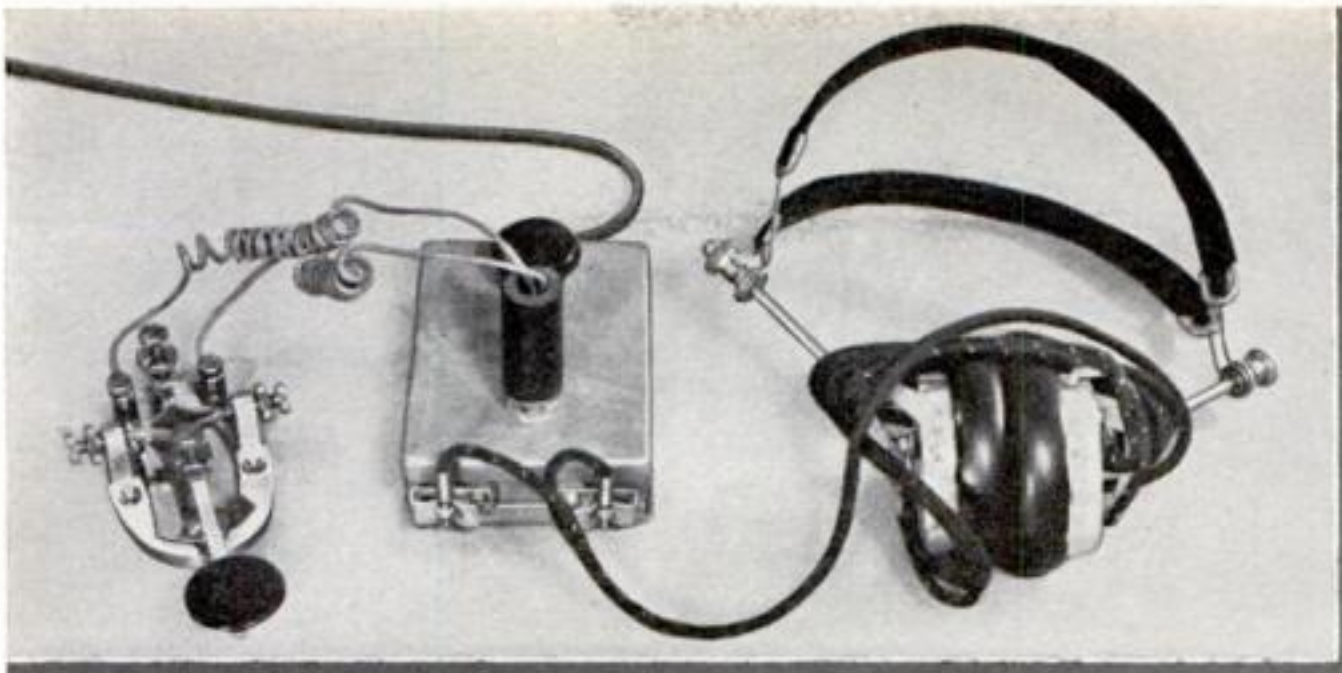
Two padder condensers, one 1S5 glass pentode, an unshielded antenna coil, and two batteries are used. Two Fahnestock clips on the card-case cover connect to phones. No ground is necessary



Above, a complete wiring diagram for the one-tube receiver, and below, the radio in its tiny case, showing tuning and regeneration controls, phones hooked up, and (between knobs) antenna connection







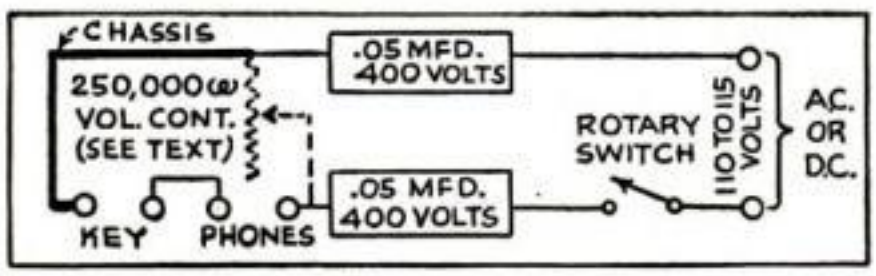
COST: $1.50—Two condensers and a resistor mounted on a chassis make up this all-electric code practice set

INEXPENSIVE, EASY-TO-MAKE

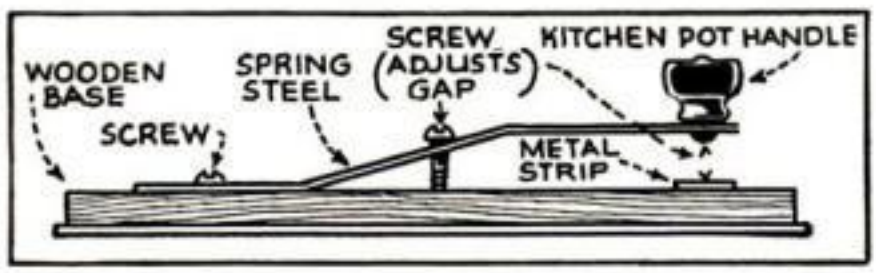
CODE PRACTICING SET

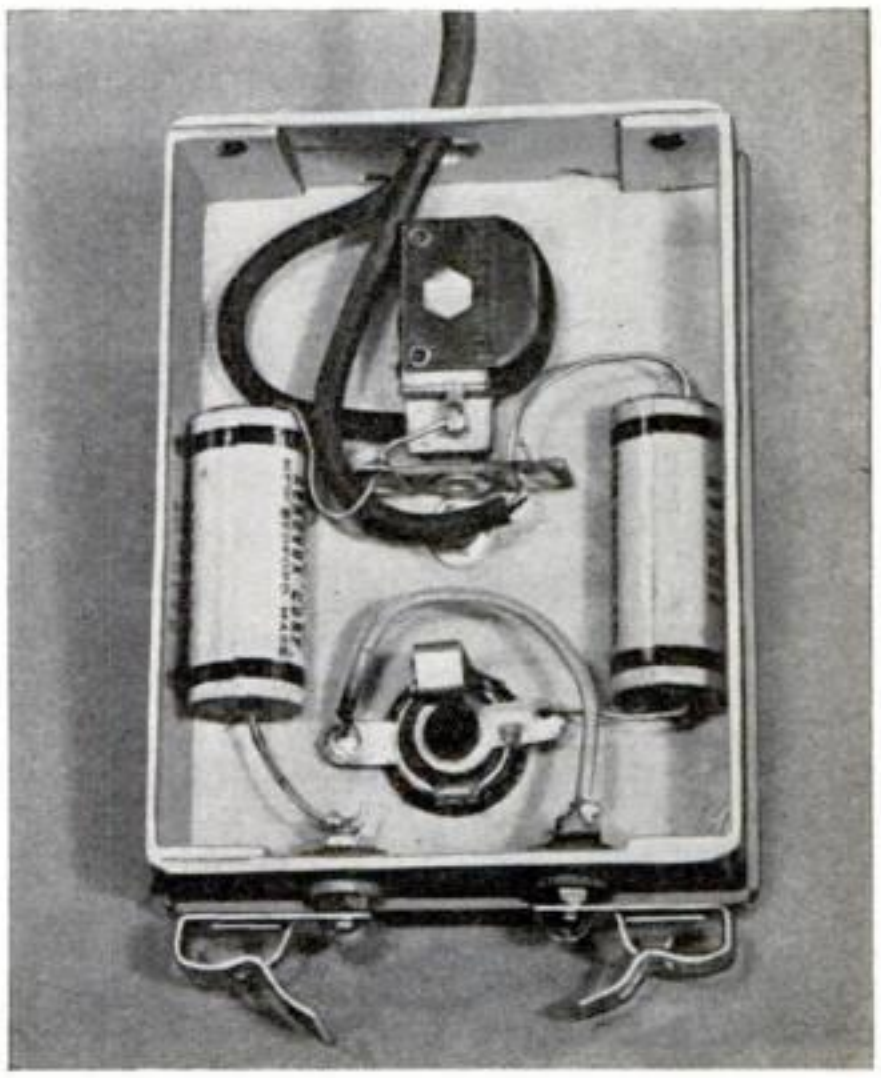
FOR men and women in civilian defense units learning telegraph code, here is a practice set which can be made at home. The unit is a simple oscillator, not a buzzer set, which uses neither audio transformers, batteries, nor tubes. It will operate on AC or DC at 25 to 60 cycles, 85 to 150 volts. If the volume of the tone signal is too loud on AC, a 100,000 to 250,000 potentiometer can be connected across the two .05-mfd. paper tubular condensers to allow a varying control of volume. Besides these tubular condensers the only other parts required are a rotary or toggle on-off switch, two Fahnestock clips for the phones, and a microphone plug and jack for the key. Any type headphone or earphone will do. A simple homemade key, for those who wish to avoid the expense of buying a regular professional instrument, is shown in one sketch. Don't steal the knob from a cooking utensil; a new one costs only a few cents.

Simple code-set oscillator for operation on AC or DC. It has practically universal application



View of the oscillator from the underside. The paper tubular condensers may be connected with a potentiometer if tone-signal volume is too loud



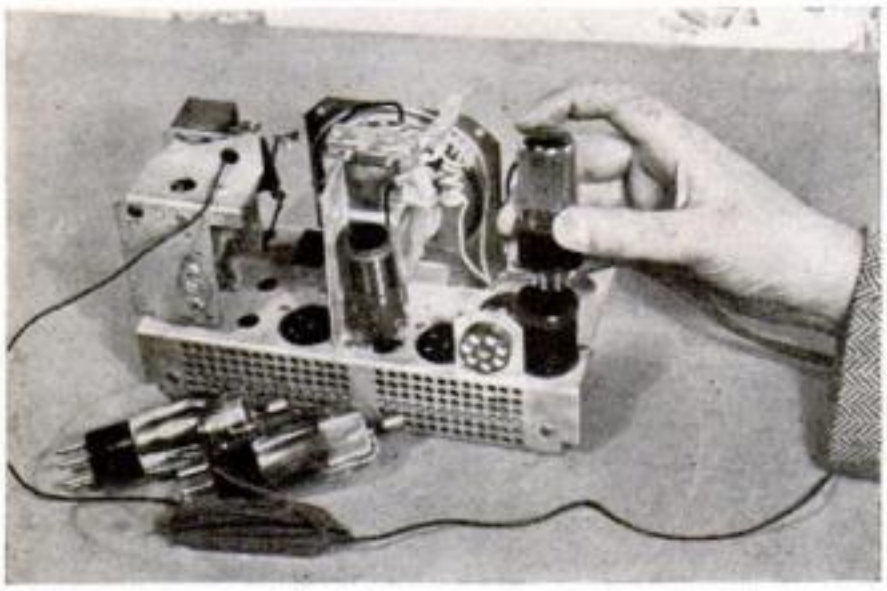


Complete wiring diagram showing all connections for the code oscillator, and, left, a sketch to aid in the construction of a simple sending key

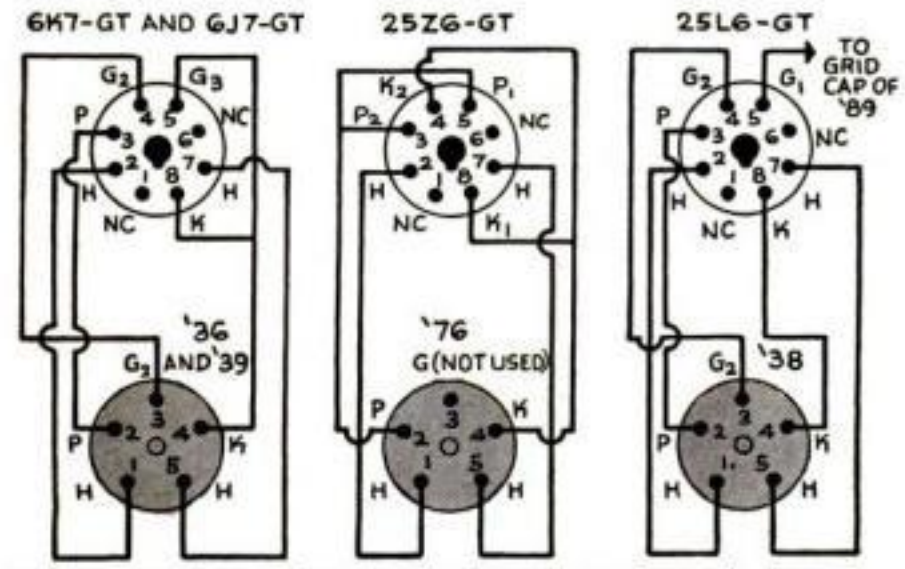
Servicing Your Radio– PART 3

THIS OUT-OF-DATE SET is not hard to fix up

NEW SPEAKER will require an output transformer



ADAPTER SOCKETS are essential for new tubes



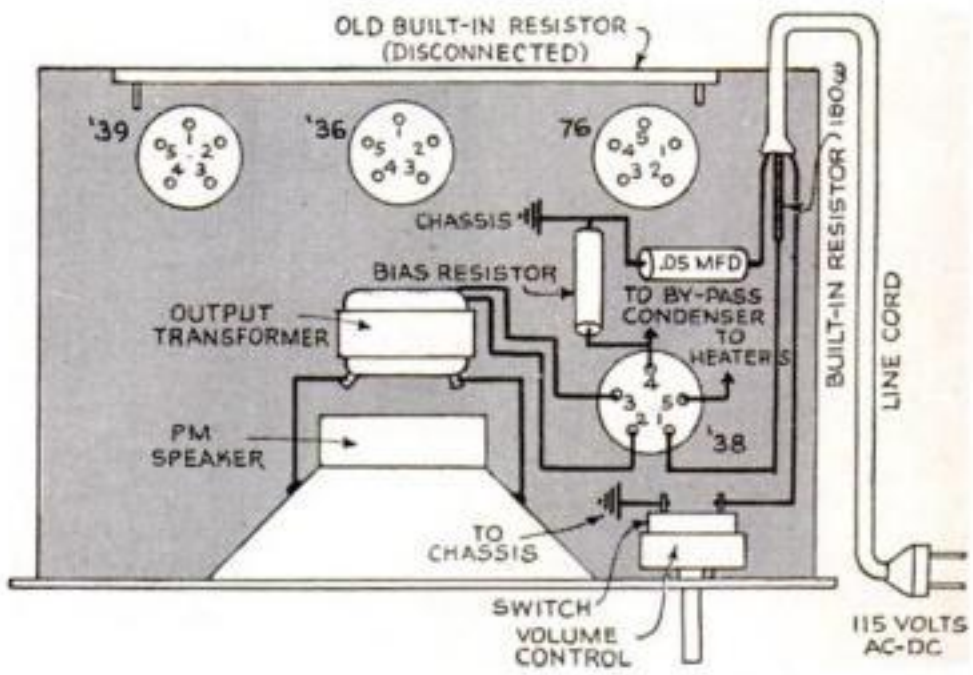
BOTTOM VIEWS SHOWN (N.B. – N C MEANS NO CONNECTION)

IF YOU HAVE an old radio set whose reception is not up to 1942 standards, you can modernize it yourself. The receiver illustrated here was one of the first AC-DC radios to use a plastic cabinet, and had no line-cord resistor, no 25Z5 or similar-type rectifier, and had a magnetic speaker.

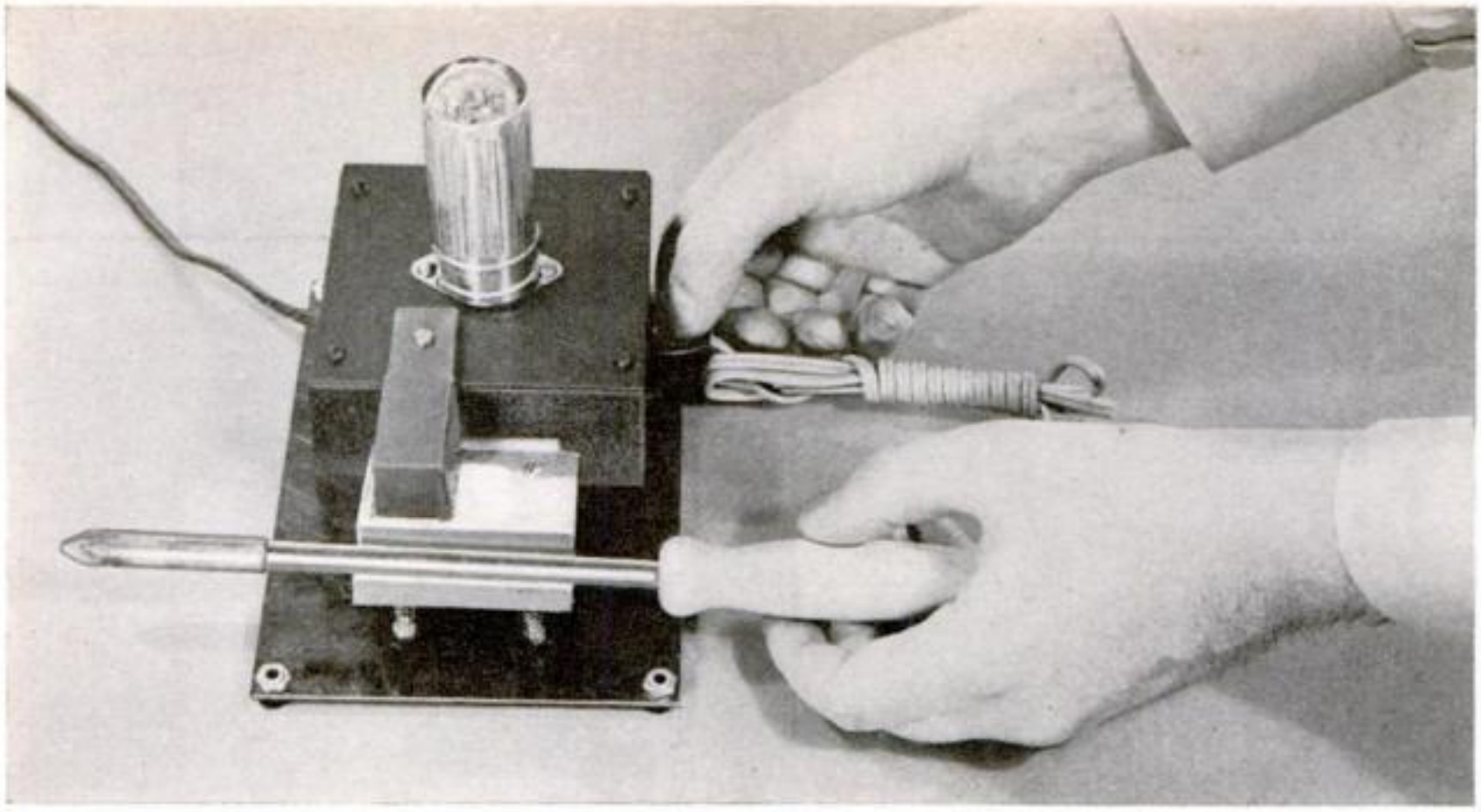
The first thing to do, of course, is to remove the chassis from its plastic cabinet. Before starting to work on the chassis, be sure to dust and clean it thoroughly. The magnetic speaker is removed from the chassis and replaced by a four-inch permanent-magnet speaker. Since no output transformer is required with a magnetic speaker, one will have to be purchased. It is mounted directly to the four-inch speaker, on top, and may be seen clearly in the picture.

The set originally used a 39 tube as RF amplifier, a 36 tube as detector, an 89 tube as power amplifier, and a 37 tube as half-wave rectifier. Since those tubes first appeared several improvements have been made, and the new tubes now have greater sensitivity and clarity. Sockets and tube bases, however, have changed also, and it is not a simple matter of plugging a new tube into the old socket in order to use the new tubes. Adapter sockets have to be purchased. To replace the 39 RF amplifier tube use a 6K7-GT, instead of the 36 detector tube use a 6J7-GT, instead of the 38 power tube use a 25L6 or 25L6-GT, and instead of the 37 half-wave rectifier tube use a 25Z6 or 25Z6-GT. In using the 25L6 power tube, the bias resistor in the set will have to be changed to one having a value of approximately 600 ohms.

In the original set, a built-in heater resistor was used. It should be replaced by a line-cord resistor of 180 ohms. This is the correct value for the tubes listed above.



Tube wirings, left; general wiring diagram, above

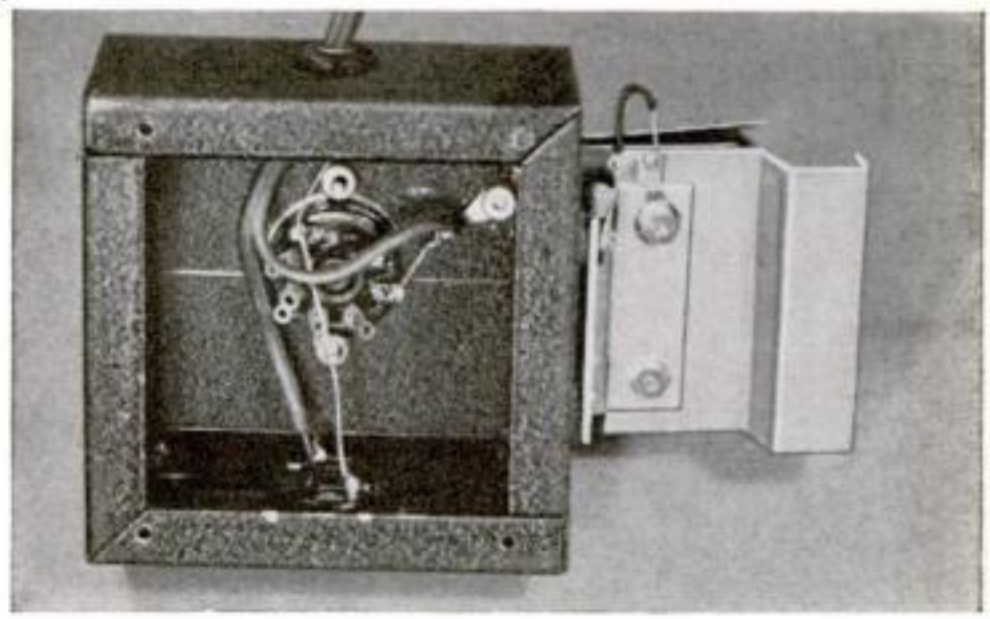


Iron's heat, automatically reduced as it is placed on the stand, remains sufficient for instant reheating

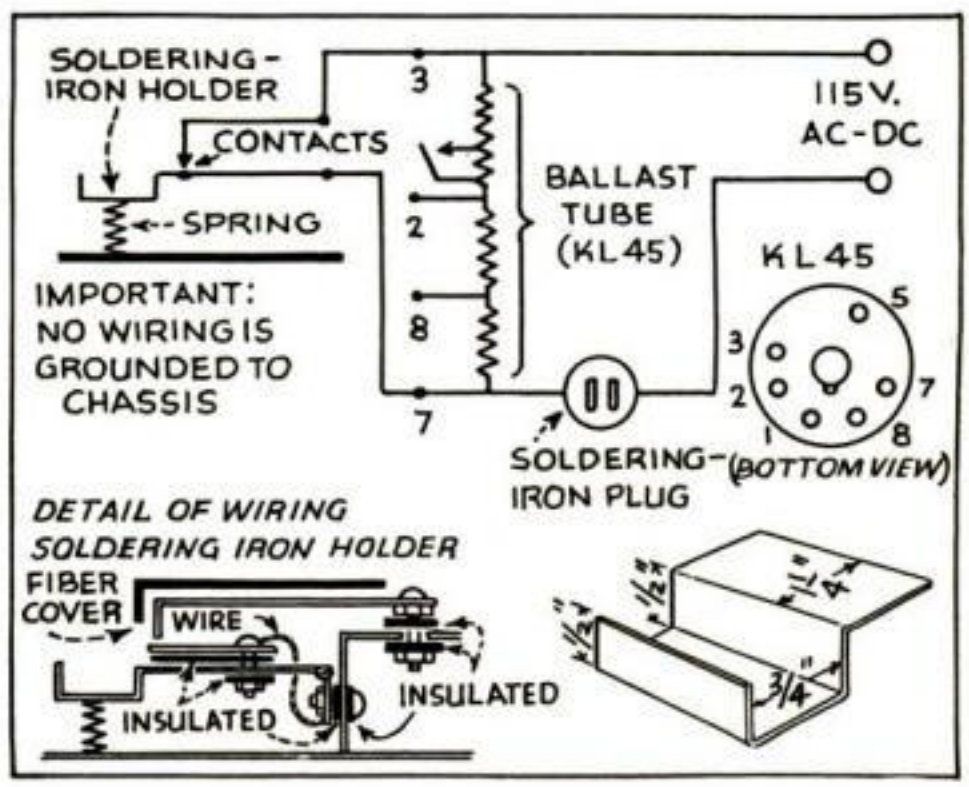
AUTOMATIC SOLDERING-IRON STAND

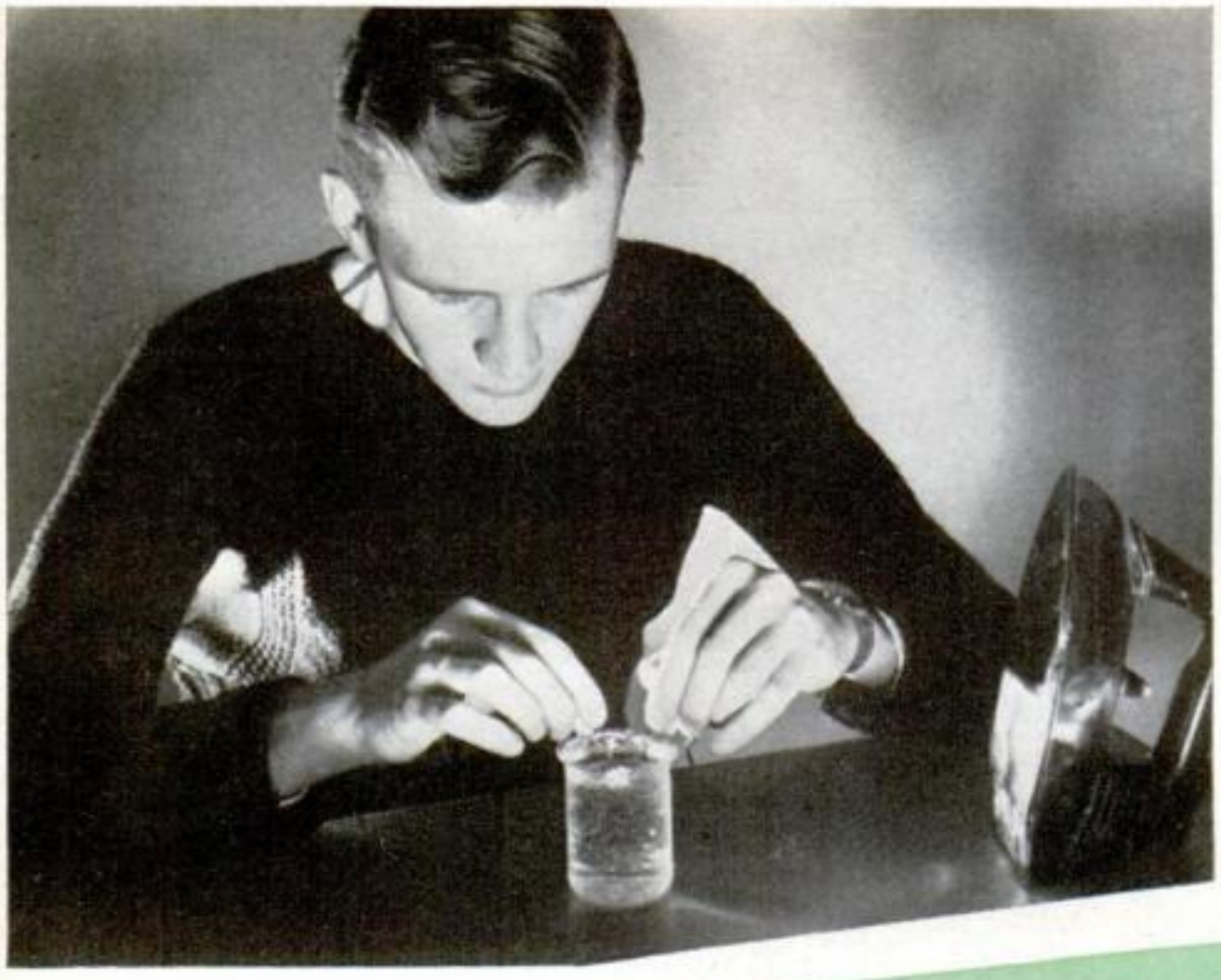
HOME-CONSTRUCTED DEVICE LENGTHENS LIFE OF TOOL

USE of this homemade automatic soldering-iron stand will lengthen the life of any electric soldering iron. By placing the iron on the stand, a resistor is automatically brought into the circuit, reducing the heat of the iron but keeping it warm enough so that when lifted off the stand it almost instantly becomes hot again. Soldering irons, when used with a stand, may be operated for several hours on end. The stand will handle irons only up to 35 watts. Linecord resistors are required for higher wattage ratings, replacing the ballast tube. The entire unit can easily be constructed at home. An ordinary door hinge supports the bracket which holds the soldering iron. Two small springs underneath this bracket prevent it from collapsing when the iron is placed on it. The special brass circuit breaker is fully insulated from the metal stand so that there is absolutely no danger of electric shocks. Heavy fiber board similar to the kind used as covers on notebooks is placed over the top of the circuit breaker or switch, preventing the danger of an accidental short. A shield similar to those used in radio receivers is placed over the resistor tube to prevent breakage of the glass bulb.



Stand seen from beneath, showing wiring, with door hinge and bracket for iron at the right. Below, wiring diagram for the device, with circuit breaker and resistor tube





Striking shades of red, blue, green, or violet are obtained in water when colloidal gold is suspended by arcing two pieces of gold hooked up with house current. Color depends on the particles' size. Red colloidal gold is the basis of the production of rich ruby glassware

FUN WITH COLLOIDS

TINY PARTICLES OF MATTER THAT CAN'T BE SEEN

NEVER met a colloid? Then you have never eaten a piece of bread, washed your hands with soap, mixed paint, nor performed any of the thousand everyday things that bring you face to face with a fascinating branch of chemistry.

More than 80 years ago, Thomas Graham, a British chemist, discovered that many chemical substances fell into two classifications: those which, dissolved in water, would pass readily through an animal membrane, and those which would not. The former were substances which crystallize from their solutions, like salt or sugar; the latter—substances such as gum arabic, albumin, and gelatin—were never known as crystals. Graham called the first class *crystalloids,* the second *colloids,* from the Greek word *kolla,* meaning glue.

Today, however, chemists believe that almost any substance may act either as a crystalloid or colloid, depending upon the size of its particles. A colloid, they hold, is an intermediate subdivision, too big to dissolve completely, yet too small to be seen.

Although colloidal particles themselves are invisible, you may demonstrate their presence simply. Into one bottle pour a solution of alcohol and water; into another, salt and water. Both liquids look equally clear, but turn out the ordinary light and shine a strong pencil of light through the bottles at a right angle to your line of vision. The difference is amazing. Passing through the salt solution, the light is practically invisible; in the alcohol and water, the beam shines out strongly. Why? The salt particles are so small that they cannot reflect the tiny light waves, but the colloidal particles in the alcohol and water, invisible under ordinary light, reflect the beam.

Colloidal gold may be produced by striking an electric arc under water between gold electrodes. The particles may color the solution blue, green, red, or violet, depending upon their size. Connect two pieces of gold, silver, or another metal in series with a resistance, such as an electric iron or toaster, and the 110-volt house current, taping the connections at the metal so as to have two insulated handles. Rub the ends of the metal pieces together under water. The arcing will soon throw off enough colloidal particles to color the water.

Foamite, a stiff foam of carbon dioxide bubbles used in fighting oil fires, owes its efficacy to a protective colloid in the form of licorice extract. Ordinary powdered gelatin, used instead of licorice, serves for a demonstration. Dissolve a little along with

Invisible colloids can be shown up by directing a strong light beam through liquids in which they are present. The colloids in a small amount of gelatin dissolved in water in the bottle at the left catch the light rays, while the plain water in the bottle to the right in the photo barely reflects the light

Under ordinary light, as below, the gelatin water is as clear as the plain

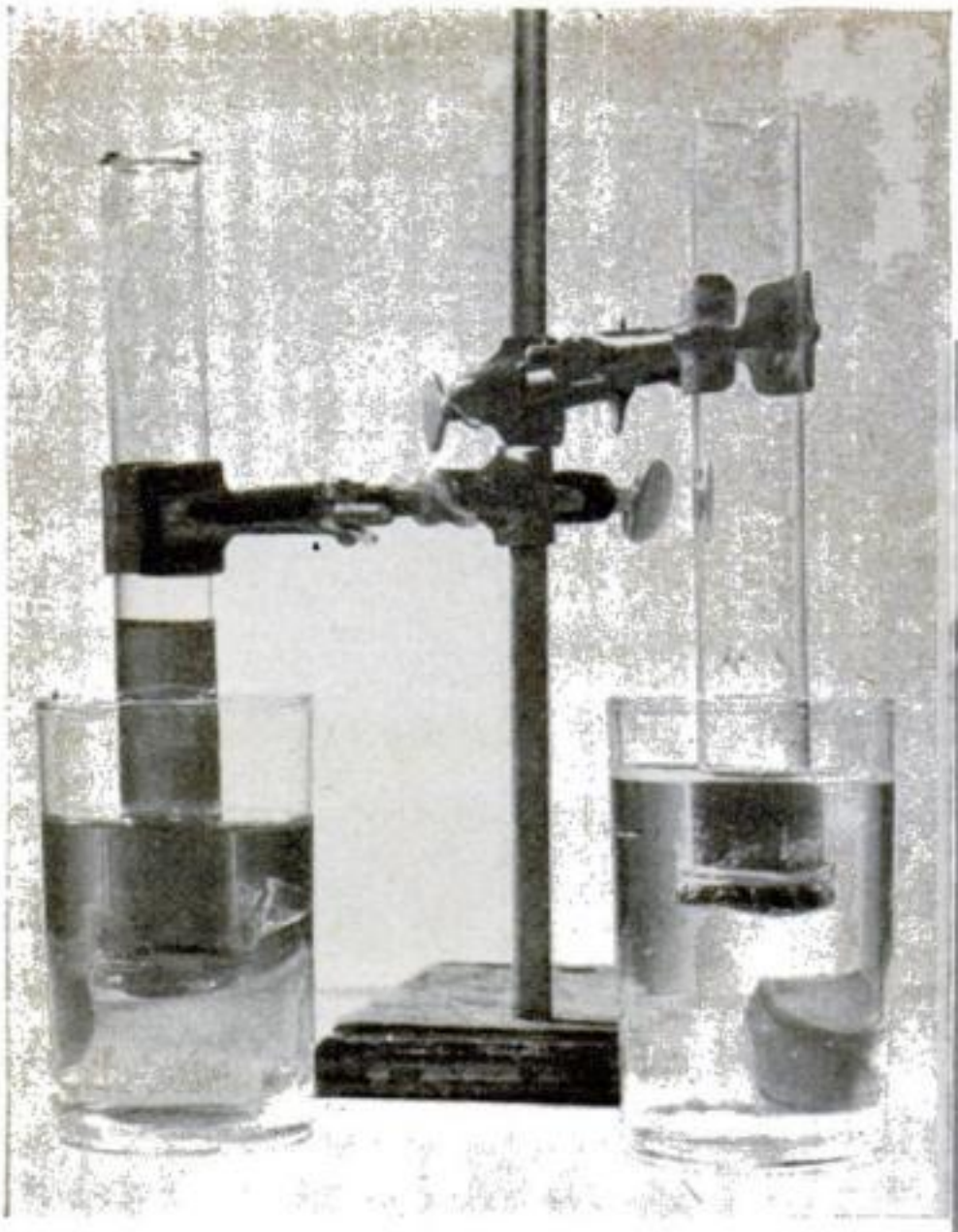
some powdered alum in an ounce or two of water, dissolve baking soda in an equal amount of water, then pour the two solutions together. A stiff foam rises immediately and stands for many minutes, the protective colloidal gelatin keeping the bubbles from breaking.

A characteristic of colloidal particles is that they are electrically charged. Remove the charge and the particles clump together and are precipitated. The American chemist Cottrell makes use of this principle in his dust and smoke precipitator by charging the air through which smoke and fumes pass. The charge de-ionizes the smoke particles, causing them to coagulate into bits large enough to fall. This cleans the air and permits valuable metallic oxides and potassium compounds to be reclaimed.

With the help of a spark coil or a small transformer, you may make a Cottrell-type precipitator, using a cereal-box "factory furnace," a joss stick for a smoky fire, and

Valuable minerals escaping in smoke are reclaimed in industry by coagulating colloids electrically. They are visible in the smoke escaping below . . .

. . . But charge the air in the stack, and the particles cling together and drop to the bottom. The principle is employed in the Cottrell process



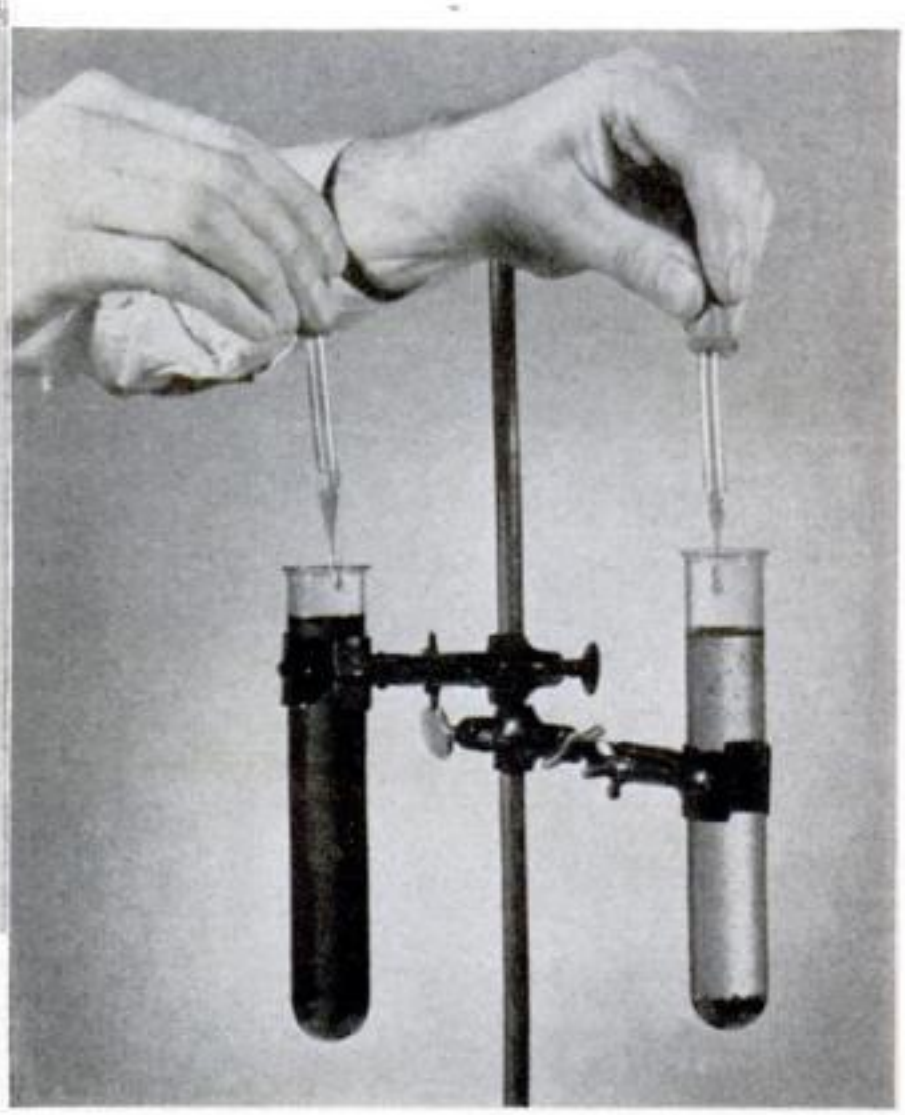
a glass-tube "stack" coated part way up on the outside with tinfoil and having a rolled-up pencil of tinfoil suspended in the center. Each piece of tinfoil is connected to one of the two secondary terminals of the coil. Current off, smoke pours out the stack; on, the smoke stops.

Because of the different size of the molecules of a crystalloid and a colloid in the same solution, they may be separated by dialysis. Put the solution in a tube having its lower end covered by animal membrane, and stand the tube in a tumbler of water. The smaller crystalloid molecules will work gradually through, while the colloidal particles remain in the tube.

To illustrate both dialysis and the difference between colloids and crystalloids, stand membrane-bottom tubes in two tumblers of water. Into one pour a solution of copper sulphate and water to the level of the outside water and into the other pour a solution of oxalic acid and water tinted by enough Prussian blue to match the copper sulphate solution. After several hours, the water in the copper sulphate tumbler will have turned pale blue. That in the second tumbler will be colorless, but litmus paper will indicate that it has become acid.

Empty the residue into test tubes and add a few drops of sulphuric acid to each. The copper sulphate solution remains unchanged, but the Prussian blue particles coagulate and drop to the bottom.

Tiny crystalloids pass through a membrane; colloids are too large. Copper sulphate in the tube at left colors water in the glass; Prussian blue in the right-hand tube won't leak out. Below, a few drops of sulphuric acid do not change the copper sulphate, but the colloidal Prussian blue is precipitated



Carbon-dioxide fire-fighting foam remains stiff because a protective colloid keeps its bubbles intact. Pour dissolved gelatin and alum and a baking-soda solution together into a cake pan for a vivid demonstration

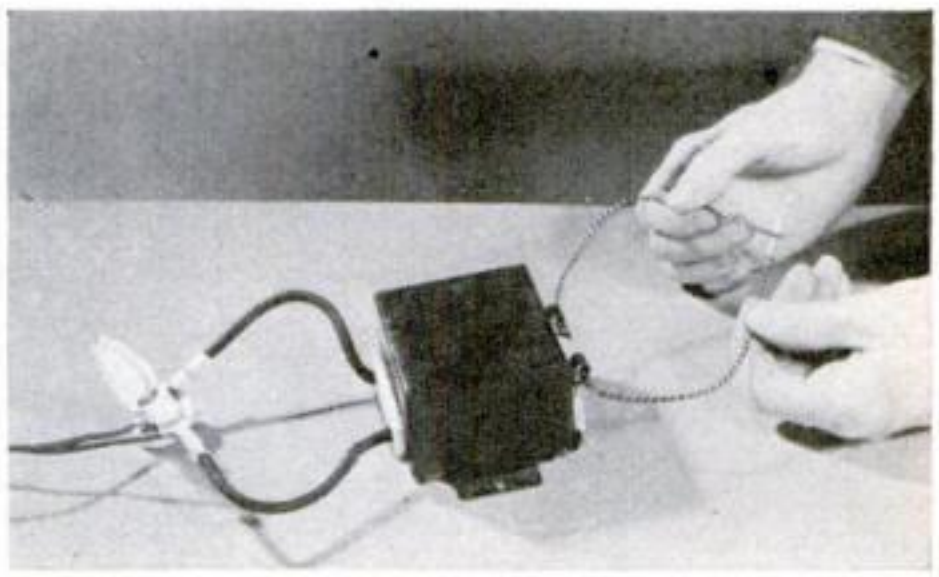
SCIENCE STUNTS

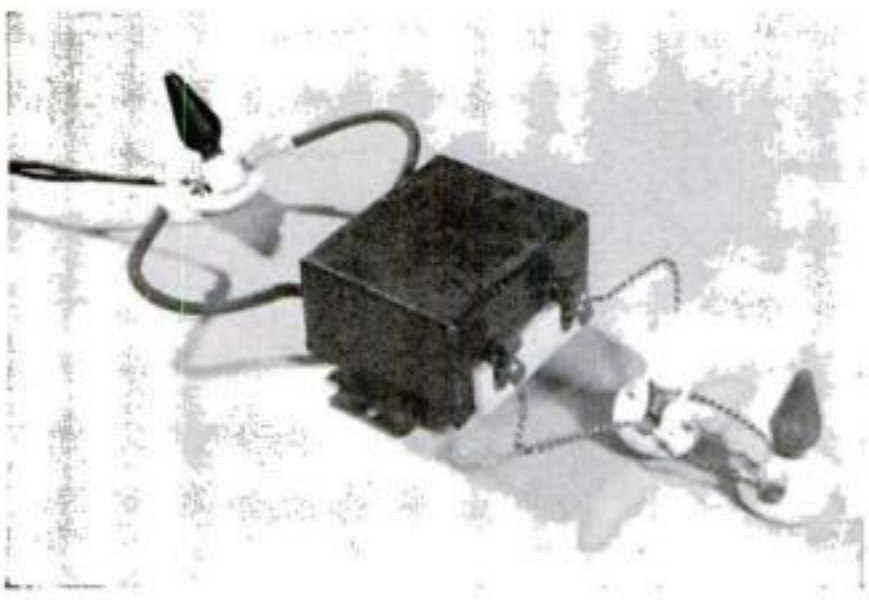
TESTS WITH ELECTRICITY

ENTERTAINING experiments with electricity and magnetism may be performed with apparatus as simple as a coil of bell or magnet wire, a pocket compass, a few dry cells, and a bell-ringing transformer—or the one that runs Junior's electric train. Among other things, they show why some alternating-current appliances burn out on direct current, and when a doorbell transformer doesn't add to your electric bill.

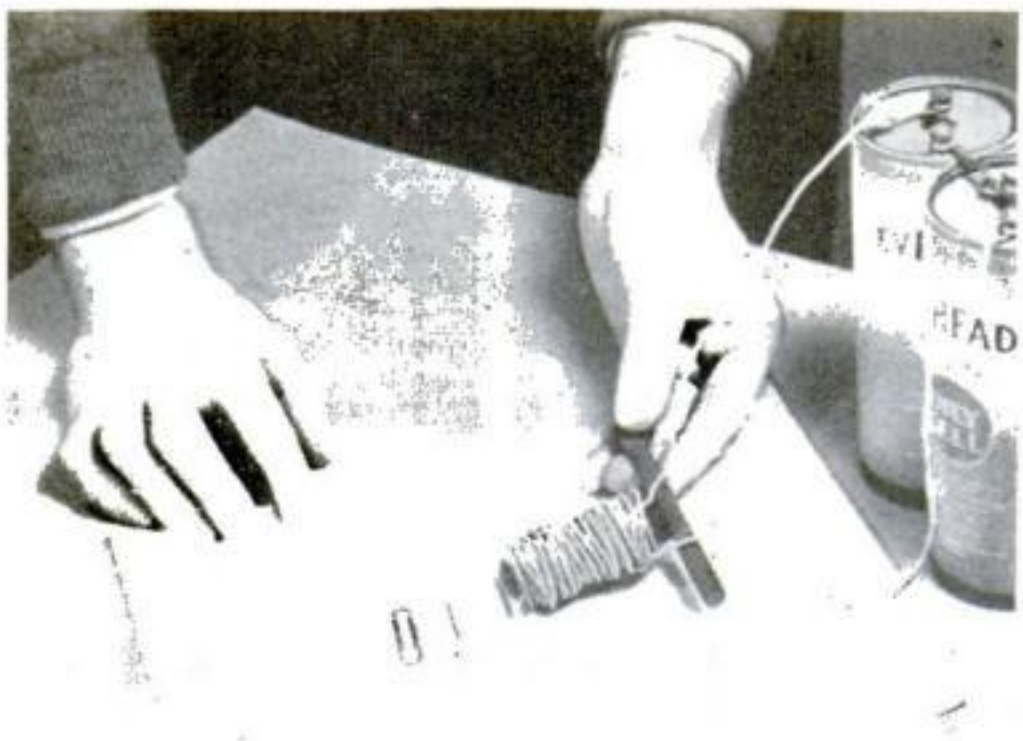
ALTERNATING AND DIRECT CURRENT. Wind 100 turns of magnet or bell wire on a paper tube of about ⅜-inch diameter, and wire this coil in series with a six-volt lamp bulb. The bulb lights with equal brightness on alternating current from a bell-ringing transformer, and on direct current from four dry cells in series. Repeat the experiment after placing an annealed iron bolt within the coil. On alternating current, the lamp is dimmed, because the coil's pulsing magnetic field opposes passage of current. Direct current encounters no such resistance. Therefore, many alternating-current motors, transformers, and other magnetic devices may overheat and burn out on direct current.

IDLE TRANSFORMER DRAWS NO CURRENT. Though permanently connected to house wires, an unused bell-ringing transformer scarcely moves the meter. A Christmas-tree bulb in series with the 110-volt supply does not light, because the magnetic field of the transformer's primary coil resists alternating current. If the secondary terminals are joined as shown, however, a new and opposite magnetic field neutralizes the first, and the glowing bulb shows that the transformer draws current from the line.

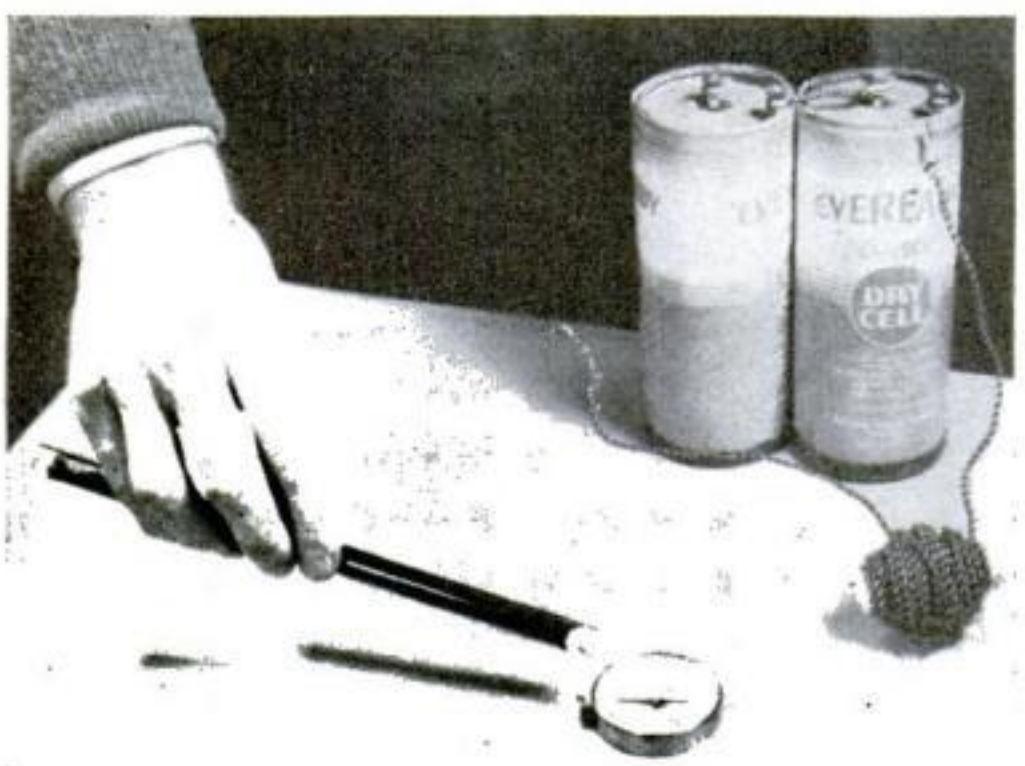




ADVANTAGE OF ALTERNATING CURRENT. Connect a Christmas-tree bulb in series with the current supply of a bell-ringing transformer; and two similar bulbs, in parallel, to the low-voltage terminals. Too little current passes through the first bulb to light it, but the higher amperage of the low-voltage side makes these two bulbs glow brightly. Alternating current is preferred for light and power because transformers can be used at generating and receiving ends. Since wire size depends solely on amperage carried, transmitting current at high voltage and low amperage saves untold metal.

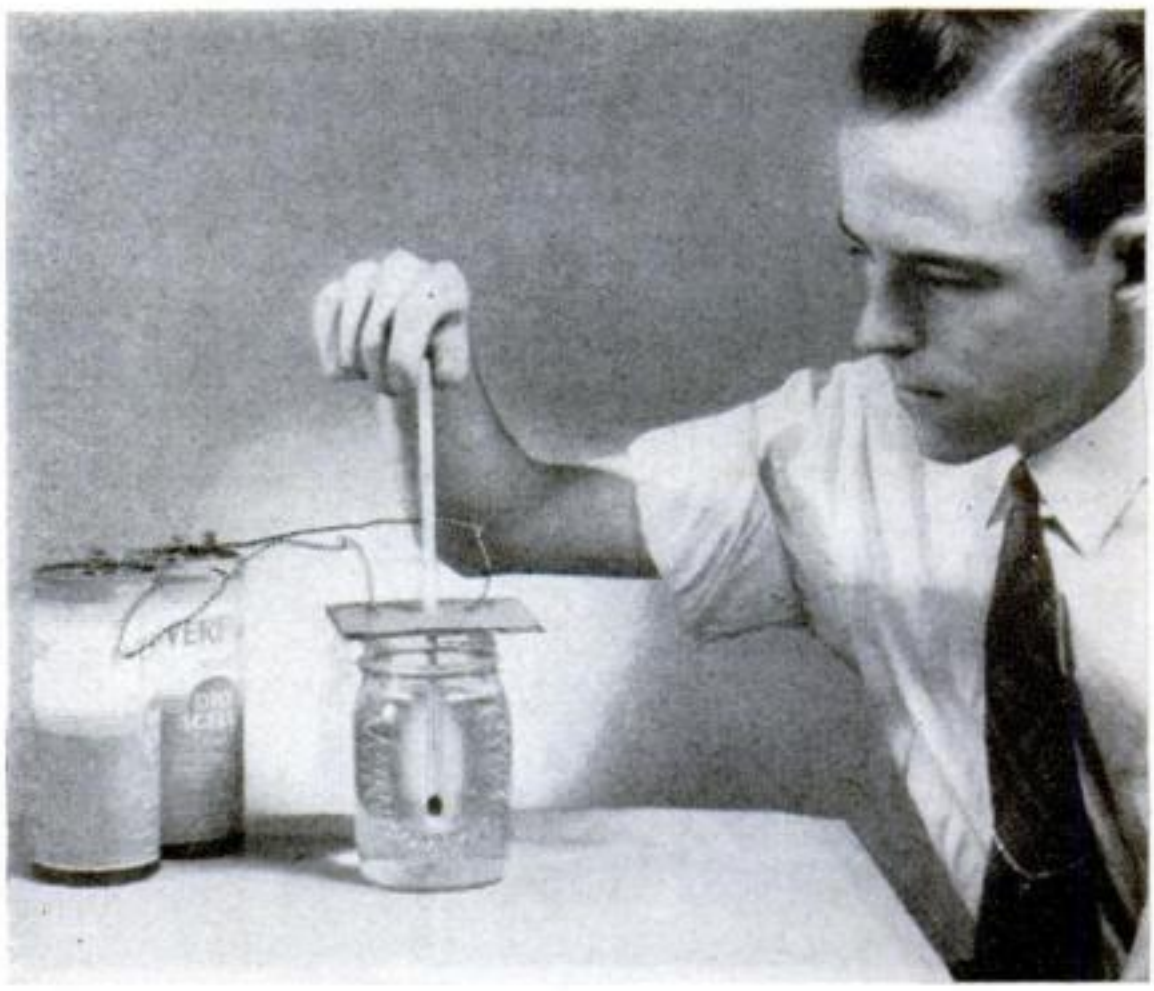


ADDING POWER TO MAGNET. Make an electromagnet by winding bell wire around a bolt, and connect it to several dry cells. Find by experiment how far away a paper clip will be attracted. Now place a second bolt across the rear magnet pole. Though this bolt is nowhere near the clip, the latter will be attracted from a much greater distance. Magnetic lines of force permeate iron more readily than air, and the added bolt gives them an easier path between the poles—or decreases the "reluctance" of the magnetic circuit. This accounts for the increased power of the magnet.



MULTIPLE MAGNET. Fill a glass tube loosely with iron filings. Thrust the tube inside a coil of bell or magnet wire. Connect the coil to several dry cells for half a minute. Carefully remove the tube without jarring the filings. Bring an end near a pocket compass; it will attract one end of the needle and repel the other. Shake the tube and try the compass test again. Now the tube will attract either end of the needle. The coil magnetized the tube by making individual magnets of countless submicroscopic iron particles, lined up in the same direction. When the tube was shaken, this alignment was scrambled, destroying the composite effect.

CALORIMETER MEASURES CURRENT. A homemade calorimeter, or heat meter, will show that electricity produces heat in proportion to the amount of current and the time that it flows. Connect the terminals of a single dry cell to the ends of a coil of bare copper wire, suspended in a non-conducting liquid such as distilled water. Let the current flow for half a minute, and note the rise in temperature of the water. Now connect two dry cells, joined in series, to the ends of the coil and repeat the test. This time the rise in temperature will be twice as great, since about twice as much current now flows through the coil.



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Gus Solves a Mystery

(Continued from page 135)

over a job when Horner came in. The superintendent was in a bad humor. "I don't want any more hanky-panky!" he snapped. "I want to know what the devil was the matter with this truck. I see you've been working on it."

Gus led the way around to the truck's side. "As you see," he said, "I've removed the gas line from the fuel tank. Notice that little pinhole in the pipe that normally reaches down into the tank? When the line was in position that hole was a couple of inches above the bottom of the tank. So long as the gasoline was above the level of the hole there wasn't any reason why the engine shouldn't run all right—which is what it did. But as soon as the level of the gasoline got down to the hole the fuel pump started to draw air as well as gasoline through the fuel line, and that made the engine lose power and miss. Because the hole—probably helped by vibration—got a little larger each day, the engine missed worse each day. Yesterday the hole got so large that the pump drew too much air with the gasoline, and the engine stalled. When I put that five gallons of gas into the tank last night it brought the level well above the hole, so of course the engine ran perfectly again."

"It sounds simple enough—now," Horner said. "But how did you figure it out?"

"It just popped into my bean after I went to bed last night," Gus said modestly. "I knew that Peter drove exactly the same route every night and that the missing started at the same place every night, so it couldn't have been anything else but the fuel line, and you had checked and rechecked all of the fuel line *outside* of the tank. It was just one of those things that make the automobile game interesting. No harm done except that Peter Jackson got scared out of a year's growth—to say nothing of you and me!"

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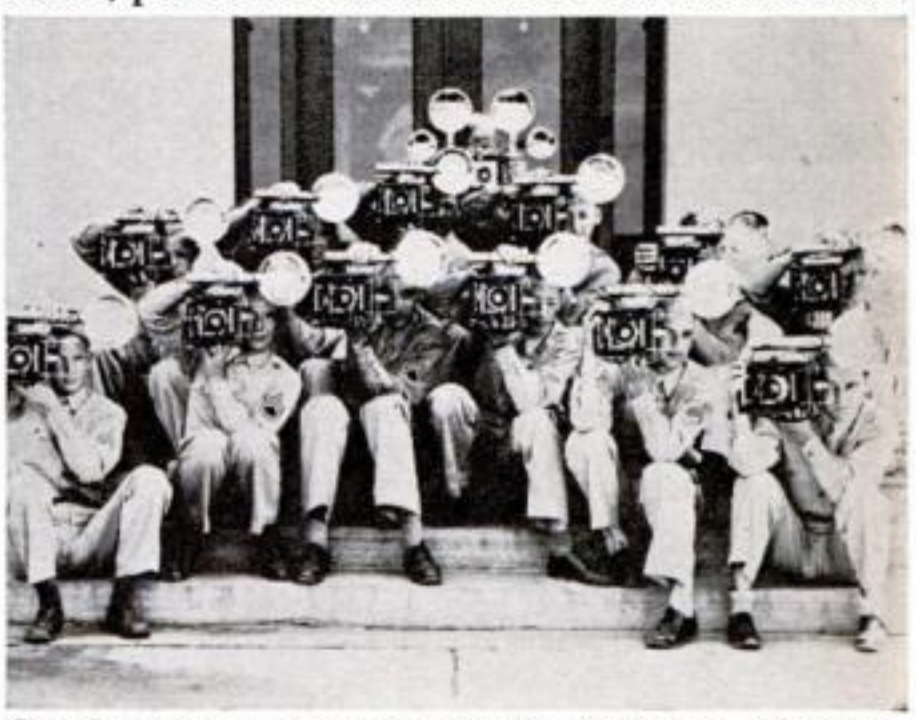

Graduates, and into Uncle Sam's Army Air Corp. They're experts now, ready for work high behind enemy lines . . recording secrets with their cameras.

Five Medical Miracles

(Continued from page 78)

up some of the stuff and tried it out, first on mice, then on Frenchmen. The vital ingredient, they found, was the forgotten Gelmo's para-aminobenzene-sulfonamide. It was then 27 years old and Gelmo's doctoral thesis stood in the way of any attempt to patent it. But its importance was obvious enough by that time. Dr. Gerhard Domagk, one of the I. G. pathologists who had discovered the bactericidal potency of the stuff, was awarded the Nobel Prize. As for Gelmo, no one knows what became of him. He received his Ph.D. and vanished. Perhaps he died in the first World War. At all events, apparently he never knew that his work was to lead to one of the greatest medical discoveries of all time.

That it certainly is, and we do not yet know to what it may lead. In the long run, perhaps the most important phase of sulfa chemistry will not be the lives it is saving at the present moment, but the scientific trend which it foreshadows. The nature of these drugs, and the manner of their application, suggests that the biological revolution is beginning—only beginning—to catch up with the industrial revolution. Heretofore most of the human effort that has been invested in the development of the exact sciences has been devoted to improvements in machinery. Progress in the biological arts and sciences, although extensive, has nevertheless tended to lag behind mechanical progress in precision and certainty.

The problems of a hospital, of course, are more intricate than those of a machine shop, but as far as possible scientific methods should be used in both, and that is the present tendency. More and more, medicine is turning from cut-and-try methods to exact measurement and to techniques based on physics and chemistry. The sulfa drugs are an outstanding example of the application of chemical engineering to the human body.

The problems which the physician, as a medical-chemical engineer, is called on to solve are complicated enough. Infection is disease caused by microörganisms invading the body and there pursuing the activities which are as necessary to their existence as they are harmful to the invaded animal. The body is equipped with defenses against the invaders—the phagocytes or white blood corpuscles. Man to man, or microörganism to microörganism, a healthy phagocyte is more than a match for any bacterium alive, but the bacteria multiply so

(Continued on page 214)

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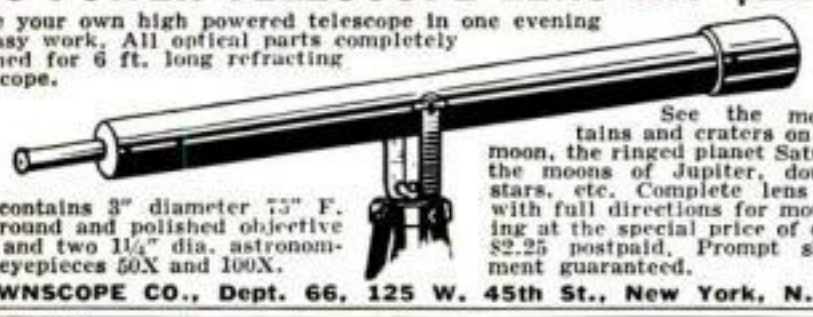

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Five Medical Miracles

(Continued from page 212)

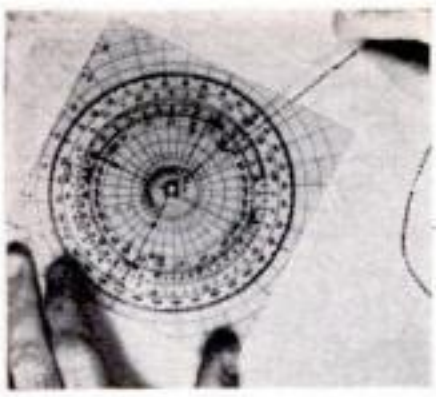
rapidly that they may overwhelm the defenders. Then the phagocytes must be reinforced, or the patient will die. Blood transfusion is one method of reinforcement. It sends fresh armies, or rather navies, into the battle. An alternative tactic is to attack the bacteria directly by chemotherapy—the introduction of an antiseptic which will kill the parasites, or inhibit their growth, without seriously harming the body tissues. The sulfa drugs are such a substance—the only one so far discovered which will cope with a variety of diseases.

Even as this is written comes news that the quintet of sulfa drugs may become a sextet, with the addition of sulfapyrazine. The new drug, developed by research workers at the University of Pennsylvania and the Abbott Laboratories, is said to be quick-acting when taken by mouth and effective against two types of pneumonia.

Although some highly scientific procedures are involved whenever the sulfa drugs are correctly administered, the mechanism of their behavior in the body is still uncertain. It does not appear that the drug kills bacteria directly. It does, however, slow down their reproduction. When this effect occurs in the body it lays the bacteria open to successful attack by the phagocytes. In the last analysis, therefore, the body must defend itself; sulfanilamide can only help it to do so.

Just how bacterial reproduction is slowed down remains problematical. According to one theory, sulfanilamide neutralizes enzymes which are essential to bacterial nutrition. Enzymes are complex organic substances which enable plants and animals to digest and utilize food, as by splitting proteins. On this basis the bacteria, being deprived of their essential enzymes, are unable to utilize the food around them. They starve in the midst of plenty.

To the patient fighting for his life, theories are of small importance. All he knows is that he feels better, or worse. How the stuff works may not be very important to the average practicing physician either, for he has the same preoccupation as the patient. But to the scientists who act as the general staff of the medical army these matters are of vital importance, for the verification or disproof of competing theories determines future lines of development. They will find out by and by, and then chemotherapy will take another leap forward. And many an ordinary man will remain longer on this earth as a result.



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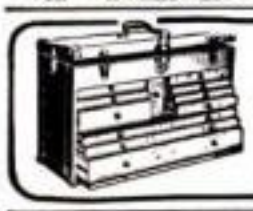

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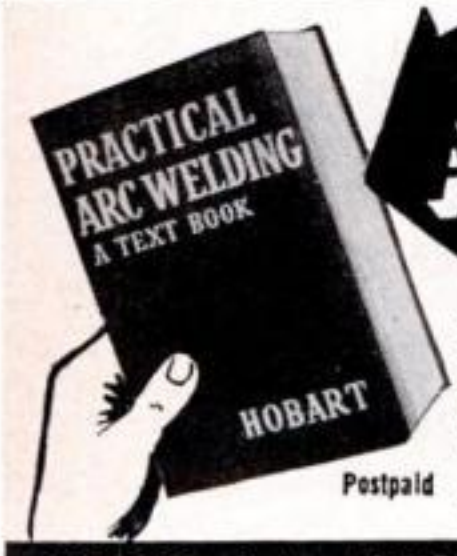

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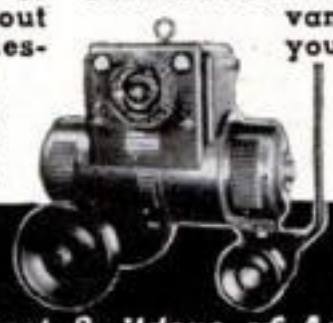

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Gas Attacks from the Air

(Continued from page 105)

the earth. If gross contamination is desired in a small area such as a bridge or a railway junction, the 100-pound thin-case bomb, which scatters the chemical over a radius of about 40 yards, may be used.

The Spaniards dropped a few mustard bombs from airplanes upon the Riff tribesmen in Morocco in the spring of 1925. There have been rumors that gas once was used from the air by the British in Afghanistan, and by Russian flyers in Turkestan soon after the first World War, but it has not been possible to verify either of these instances. The Italians are known to have used mustard gas from aircraft in the Ethiopian War in 1936, with great effect.

The purposes of air chemical attack are to create casualties to hostile personnel; to contaminate hostile areas, such as airdromes and important ground, and deny their use to the enemy; to contaminate enemy material and supplies, such as airplanes, bombs, ammunition, and food; to threaten hostile equipment and personnel and thus delay operations and require the enemy to carry means for protection and decontamination; or to cause damage by fire.

The possibilities of incendiary bombs have been thoroughly explored during the present war. Scarcely a bomber takes off today on a hostile mission without some share of its load being taken up by incendiaries. The most widely used of these weapons is the small magnesium bomb. The Germans have one weighing 2.2 pounds, their so-called "electron" bomb, and the British use one that weighs about four pounds.

The typical small bomb of this type has a body of magnesium alloy and sufficient thermite filling to burn intensely and ignite the magnesium body when fired by a simple impact fuse. They are generally dropped in clusters, or within a large bomb case which opens in mid-air—the famous Molotov bread basket of the Russians. By this means the baby bombs are scattered over a wide area. They burn fiercely, developing a temperature of approximately 4,000 degrees F., and will ignite anything combustible with which they come in contact.

These small incendiaries are much more efficient for general purposes than the large oil bombs which have been used in Europe. The latter contain as much as 16 gallons of oil and produce a tremendous amount of heat, but are so large that only a few of them can be carried. Small oil bombs should prove more effective, and their use may be expected.

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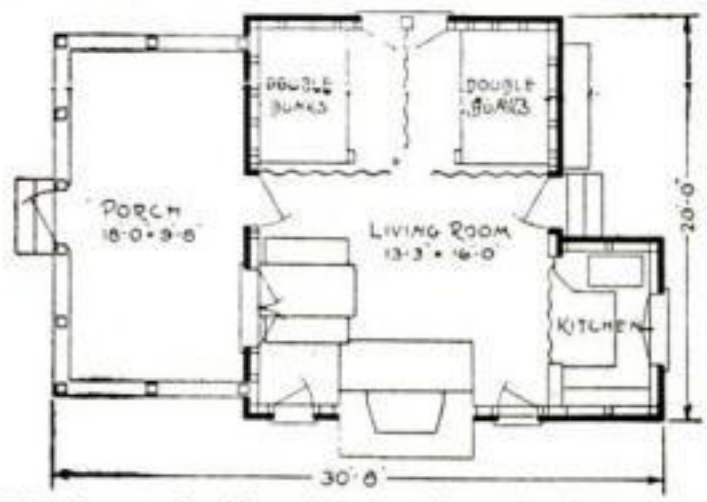

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1 in. or 2 in. . . . EASY TO READ

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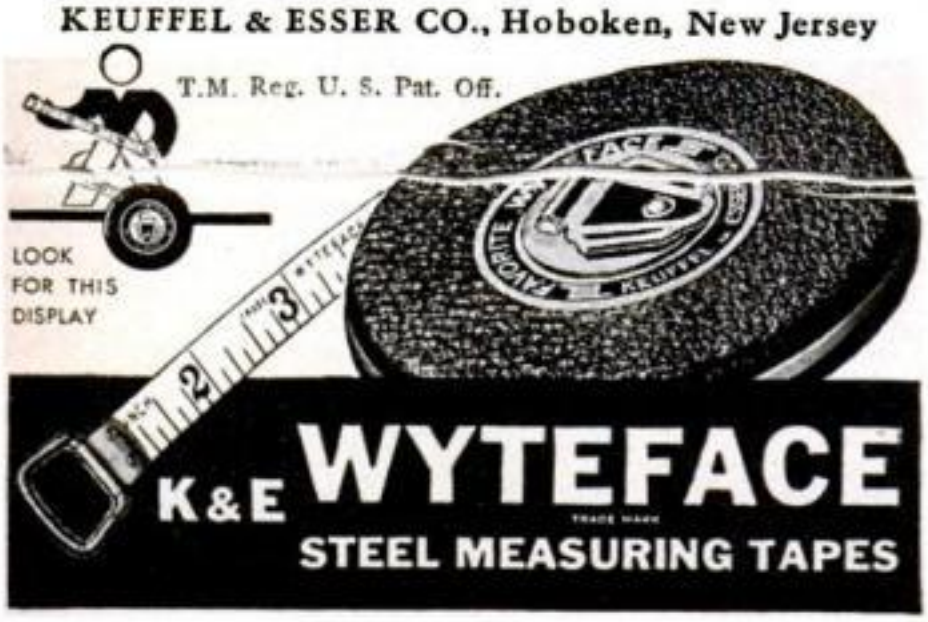

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Keep NEW brushes soft
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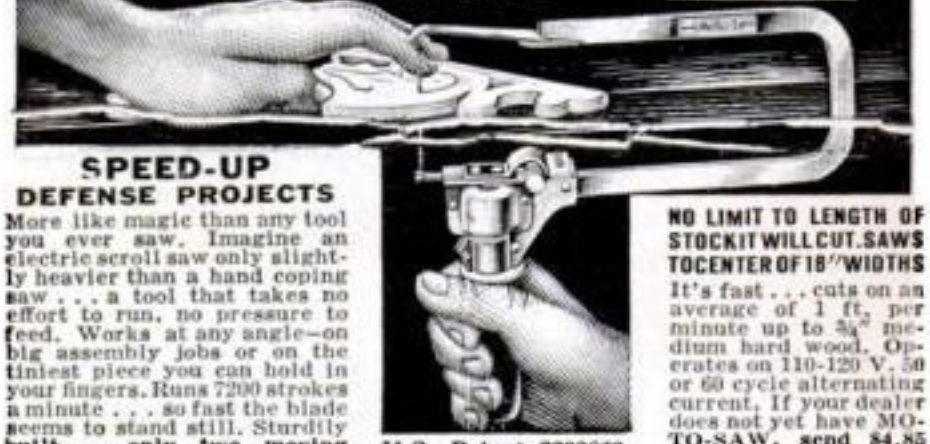
Conserve valuable paint brushes. *Save them* by using DIC-A-DOO PAINT BRUSH BATH after every use. Amazingly efficient in loosening, washing away paint from bristles. Brush remains good as new for long time. Restores old hardened brushes to usefulness. Costs only 5 cents—enough to clean several brushes. Get it at hardware or 5-&-10c stores. You'll want to keep several packages on hand.

THE PATENT CEREALS CO.
makers of Dic-A-Doo Paint Cleaner
GENEVA, N. Y.

New IMPROVED Electric MOTO-SAW

New Blade Holder Faces Blade 4 Ways . . . Multiplies Capacity



SPEED-UP DEFENSE PROJECTS

More like magic than any tool you ever saw. Imagine an electric scroll saw only slightly heavier than a hand coping saw . . . a tool that takes no effort to run, no pressure to feed. Works at any angle—on big assembly jobs or on the tiniest piece you can hold in your fingers. Runs 7200 strokes a minute . . . so fast the blade seems to stand still. Sturdily **built . . . only two moving parts . . . never needs oiling. Easily cuts intricate designs—so smooth eliminates sanding. SAFE AS A HAND SAW JUST GUIDE IT!**

U.S. Patent 2233862
Other Patents Pending

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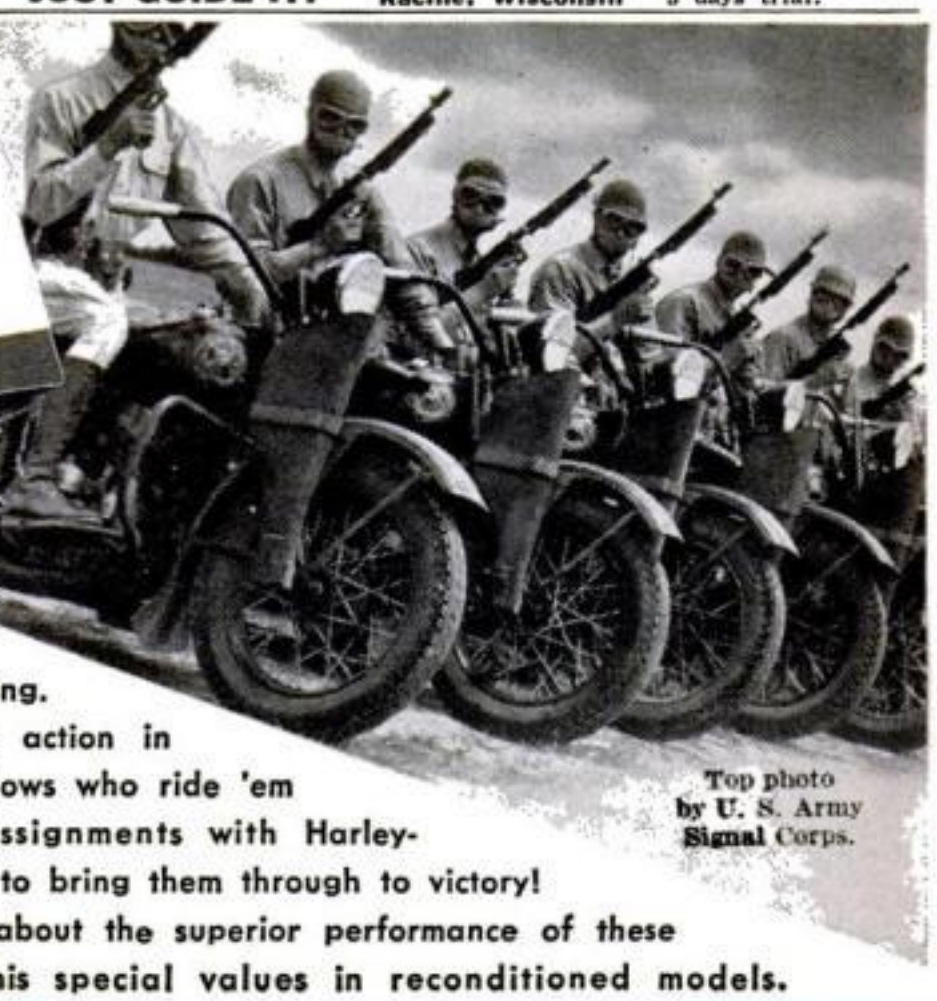
Racine, Wisconsin

NO LIMIT TO LENGTH OF STOCK IT WILL CUT. SAWS TO CENTER OF 18" WIDTHS

It's fast . . . cuts on an average of 1 ft. per minute up to ¾" medium hard wood. Operates on 110-120 V. 50 or 60 cycle alternating current. If your dealer does not yet have MOTO-SAW, **send $4.85 . . . we'll pay postage. Or send $1, pay postman balance plus postage. MONEY BACK if not delighted after 5 days trial.**

They're Riding HARLEY-DAVIDSONS!



YOU bet, Uncle Sam has to have motorcycles that are dependable — that are built to stand the gaff of roughest going. That's why Harley-Davidsons have been chosen for action in the nation's hard-hitting motorized divisions. The fellows who ride 'em are getting real action as they handle toughest assignments with Harley-Davidson's power, stamina and rugged dependability to bring them through to victory! See your Harley-Davidson dealer — and learn all about the superior performance of these world champion motorcycles — also look over his special values in reconditioned models.

Top photo by U. S. Army Signal Corps.

SEND COUPON NOW

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Send FREE copy of big 24-page "Enthusiast" magazine filled with thrilling motorcycle pictures and stories. Also literature on the latest Harley-Davidsons. Stamp is enclosed for mailing cost.

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HARLEY-DAVIDSON

Rural Fire Truck Draws Water from Garden Hydrants

IN A DISTRICT where there are no fire hydrants, a suburban or rural fire department often has to drive a long way to refill the tank truck when it becomes empty. This can sometimes be avoided by drawing water from nearby garden hydrants through a homemade manifold of the type illustrated.

The manifold is made from a short length of 2″ pipe. Holes are drilled on one side of the main barrel for six ¾″ valve connections to which garden hose can be attached. A 2″ connection to take a regulation 2″ fire hose is inserted in the center of the opposite side of the barrel, and the ends are sealed tight. This hose feeds the fire engine, providing a continuous supply as water is pumped out. To be assured of ample small hose, the Colonial Heights Volunteer Fire Department, of Sacramento, Calif., which devised this feed system, includes six long sections of heavy-duty garden hose in its equipment.—F. LELAND ELAM.

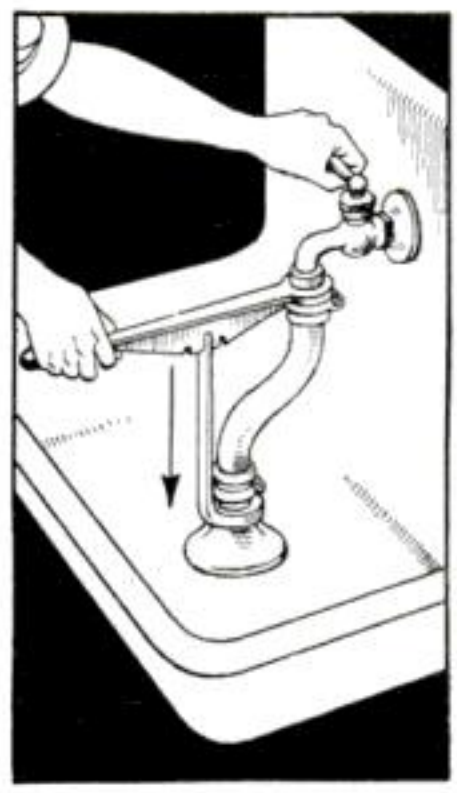
Invisible Poster Stickers

TO ATTACH cardboard posters invisibly to glass, dip small squares of clear celluloid in acetone and press these quickly in place between the glass and the corners of the sign.

With the Inventors

A HAND-PROPELLED "outboard motor" for rowboats, designed by John E. Bevington of Cleveland, Ohio, enables a fisherman to stalk his game without noise or vibration. Turning a crank transmits power through a flexible shaft to a

small propeller, slowly and silently maneuvering the craft either forward or backward. To steer the boat, the crank and its rigid shaft housing may be swung to either side. By fitting the crank to either of a pair of spindles, two speeds are provided. The demountable equipment is intended to supplement, and not replace, oars or an outboard motor used in traveling to and from the fishing grounds. . . . SOMETHING HAS TO GIVE, when a stopped-up drain pipe comes up against a new tool devised by Albert J. Matter of Park Ridge, Ill. His implement, a powerful improvement upon the common hand force pump or "plumber's friend," applies the full force of city water pressure to sweep away obstructions. Downward pressure on a hand lever forces a nipple upward against a sink faucet, and a flushing head downward against the drain opening, connecting the two with pressure-resistant hose. With the other hand, the faucet is now gradually turned on, as illustrated, until the hydraulic pressure clears the drain pipes. Whether the faucet is smooth or threaded makes no difference. Likewise, the horizontal distance from faucet to sink drain does not matter; the U-shaped upper end of the vertical



(Continued on page 222)

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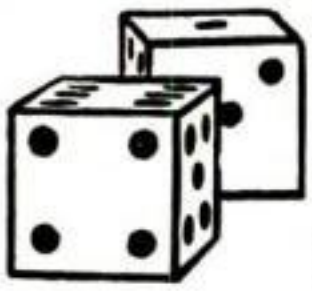

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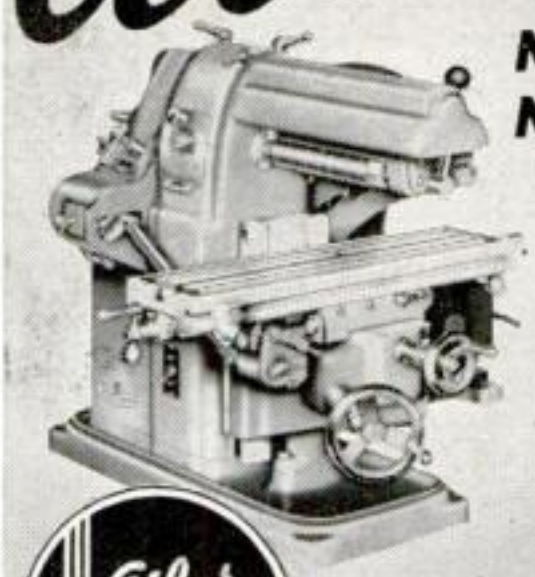
Atlas BENCH MILLING MACHINE



Key precision unit for the production of many a small but vital armament part is the compact Atlas Milling Machine. It handles the full range of milling work from slabbing and facing cuts to end milling, finishing, and layout work.

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NEW Grinding Attachment

For 8" to 16" Metal Lathes. Build It Yourself.

At last, a precision grinder within your means. You save 2/3 by finishing our semi-machined castings, on your own lathe. HURON handles both *internal* and *external* grinding. Accuracies to .00025". Mirror finish easily obtained. Grinds *valves, pistons, bushings, shafts*, hard or soft, *holes, lathe centers*. Sharpens *reamers, milling cutters*. Does *eccentric drilling; laps; polishes;* scores of other uses, for home workshops, garages, machine shops. Write for *FREE* illustrated folder and price list of supplementary items. Mention your lathe.

Semi-Machined Castings Only $6.45

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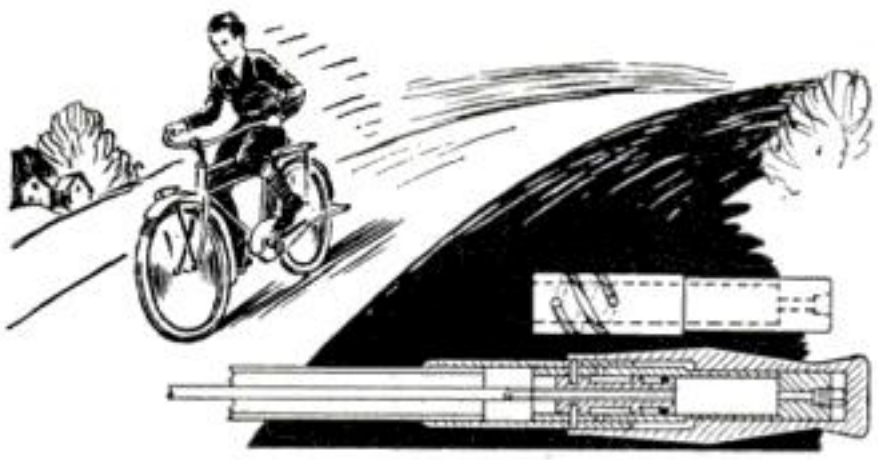
Makers of STAR hand, power Hack Saw Blades, Frames, metal cutting Band Saws, Clemson D-17 Precision Lawn Machine.

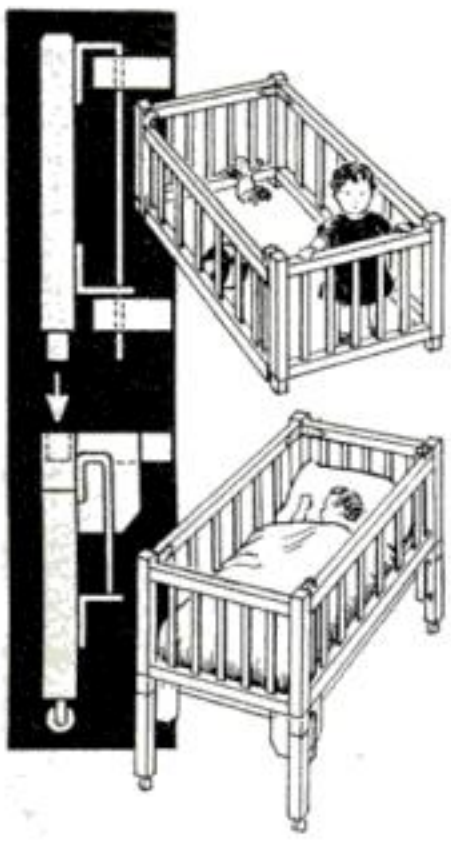
With the Inventors

(Continued from page 220)

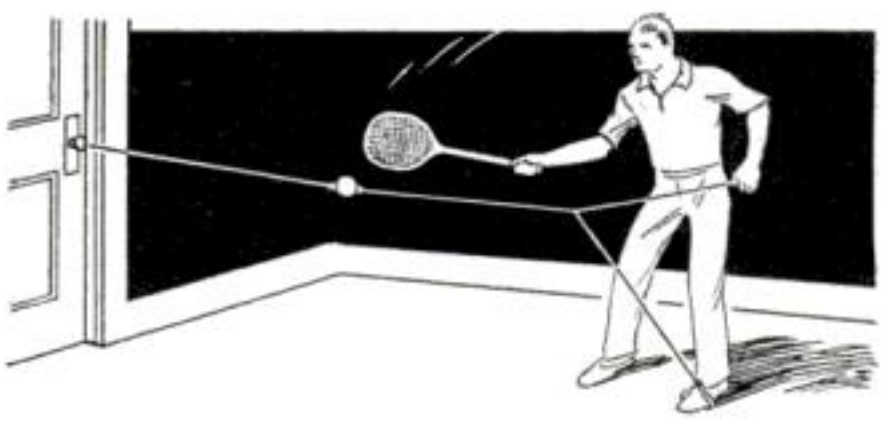
pressure-applying member simply is fitted into the nearest of several slots on the underside of the hand lever. . . . HYDRAULIC BRAKES FOR BICYCLES may now be operated by a simple manual control developed by Homer L. Mueller of Cleveland, Ohio. When



one of the handlebar grips is turned, the brake is applied or released. Revolving with the grip, a spiral-slotted sleeve withdraws or advances between a tubular extension of the handlebar and an interior thrust block, the last two being held in fixed relation by pins passing through the slot in the sleeve. This diminishes or increases the capacity of a small reservoir of hydraulic brake fluid. In the first case, excess fluid is forced out of the reservoir through a central aperture in the thrust block, and passes through a copper pressure line to the rear hub, where it actuates the brake. Turning the grip in the opposite direction allows the fluid to flow back to the reservoir. A flexible section of the pressure line permits the handlebars to be turned without restraint. . . .



THREE PIECES OF NURSERY FURNITURE are combined in one by F. B. Kratky of Lemay, Mo. Completely assembled, his outfit serves as a baby's crib. A play pen is provided simply by removing the top section and setting it on the floor. When the child grows older, the lower section, without the bars, makes a comfortable bed. As a crib, it offers the popular drop-side feature, permitting one side to be lowered. When the crib top, or play pen, has been outgrown by a child, it may be folded for storage. Accompanying views illustrate the play pen, the crib, and the construction of the corner posts, with extensions from the upper section fitting into sockets in the lower one. The framework may be made either of wood or of metal. . . . FOR THE FEAT of inventing a new knot, when it seemed that all possible bends and hitches had long since been devised, U. S. Patent 2,272,332 goes to Wilbur C. Sisson of Seattle, Wash. His surprisingly simple manipulation serves for joining a leader to a fish-hook equipped with a clamping ring, also of his own design. When loops have been formed as in the larger view, a tug on the ends draws in the slack and produces the non-slipping knot shown in the inset. To loosen it, the main leader portion is given a downward push, and the clamping ring is swung away from the eye portion of the hook. According to the inventor, the scheme makes short work of attaching and detaching hooks, and proves especially useful with leaders of modern materials that tend to become slippery when wet. . . . INDOOR TENNIS PRACTICE, usually a menace to everything breakable, has been made safe and zestful by Stowell W. Mears, of New York City. His invention provides a ball tethered



on a resilient cord, of which one side is attached to a doorknob or any secure anchor. At its other side, the cord is divided, one end being grasped in the player's hand and the remaining end looped around a foot.

NOW.. a DYNAMIC HEAVY DUTY INDUSTRIAL WELDER

THE BOOM IS ON IN WELDING— EARNINGS ARE SKYROCKETING

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WORKS OFF 110 VOLT ELECTRIC LIGHT CIRCUIT

Thousands of welders have already left their jobs and shops to get "wartime" pay in plants devoted to defense production, such as ship building, tanks, airplanes, munitions, etc. Also, in the erection of industrial plants, bridge construction work, etc. This creates an unusual opportunity for men everywhere to get in the welding business right in their own communities, and take over the work these men have left behind. No special training is required, for now with the new DYNAMIC Super-Charged Transformer-Type Welder that works off a 110 volt electric light circuit, men without previous experience, by following the simple, concise home instructions can quickly do finished repair jobs. In this way you may fit yourself to qualify for a big pay job in the defense industry.

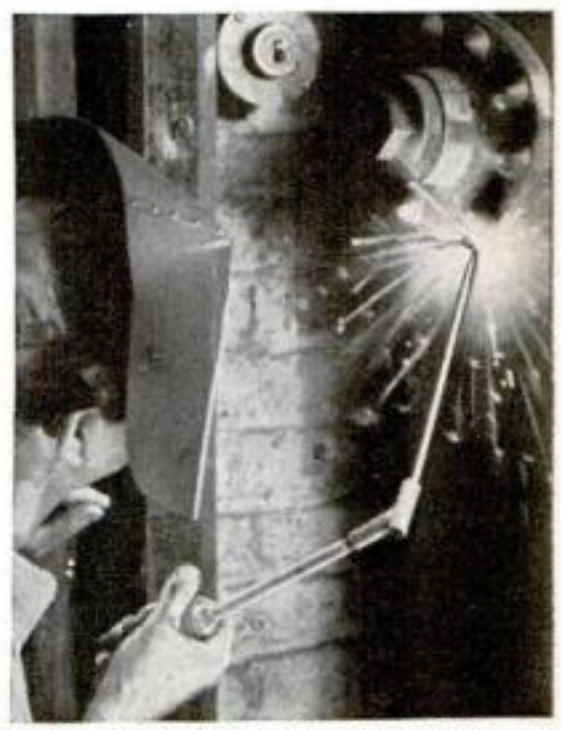
WELDS BUMPERS, FENDERS, CYLINDER BLOCKS, BODIES, FRAMES, ETC. Does Farm, Factory and Home Repairs

Many welders make as much as $15 to $20 a day. Repair jobs that can be done in less than an hour can make as much as $5.00. Any number of jobs can be done more efficiently with welding. The DYNAMIC Super-Charged Welder, despite its serviceability, is so easily portable it can be carried around by hand and taken right to the job. This is an added feature whose value you will appreciate once you are in welding.

These pictures show how easy it is to operate the Dynamic Super-Charged Welder.

WORKS ON IRON STEEL, TIN, BRASS, COPPER, AND ALL OTHER METALS

With this Welder you can work on all kinds of metal—nothing will stump you—you can tackle anything and in no time at all you will be able to do finished repair jobs that will do credit to an expert.



DOES METALIC AND CARBON ARC WELDING

Can be used efficiently on both types of welding. The cost of using the DYNAMIC Super-Charged Welder is amazingly low—costs only a few cents an hour to operate. It is built so strongly that repairs are practically unknown—you'll never have to worry about them. It cools so efficiently that you can use it continuously without ever having to stop in the midst of a job to let it cool down. COSTS LESS THAN 6c A DAY. You can buy the DYNAMIC Super-Charged Welder on easy payments. Over a year's time, it would cost you less than 6c a day. Once you have your DYNAMIC outfit, you are all set in a profitable welding business of your own—you boss it yourself. Send coupon for free particulars today.

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Electrician says: "It is the best welding outfit." I wish to tell you that I demonstrated your welding outfit to a great many people, and they all agreed with me that it did the best welding job they ever saw. A. L., Bristol, Conn.

Mechanic Praises Welder

I have received my welder and like it very much. I am a mechanic and electrician by trade, so I can appreciate its usefulness to others. P. C., Perry, N. Y.

Repair Shop Owner Tells About Dynamic

I want to say I operate a repair garage and I am more than satisfied with the welder. It will do more than you say. C. P., Butler, Ohio.

Greatest Portable Outfit

I must say it's the greatest portable outfit any man could wish to own. You may put me on file as a booster. W. J. B., St. John, N. B., Canada.

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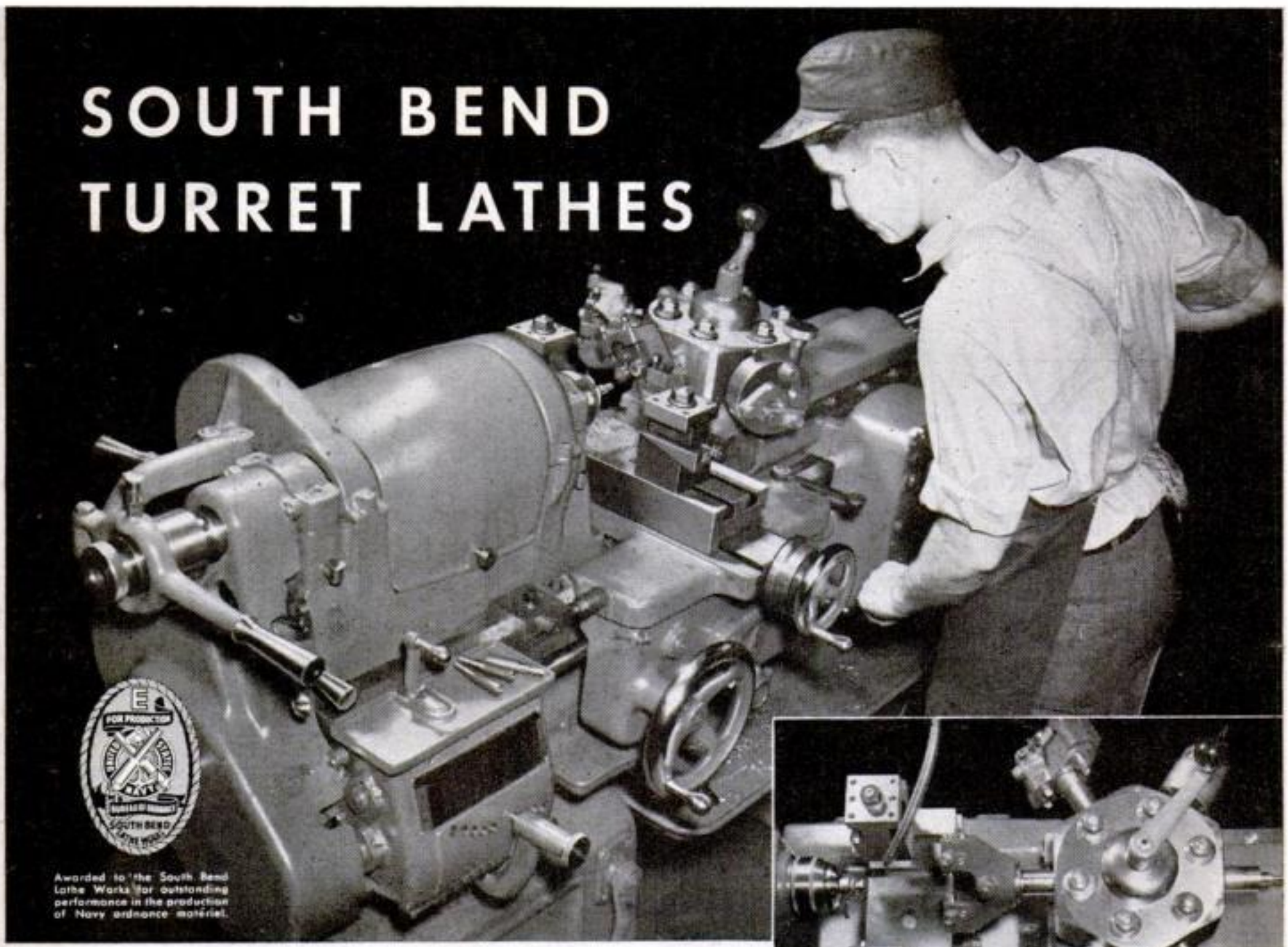
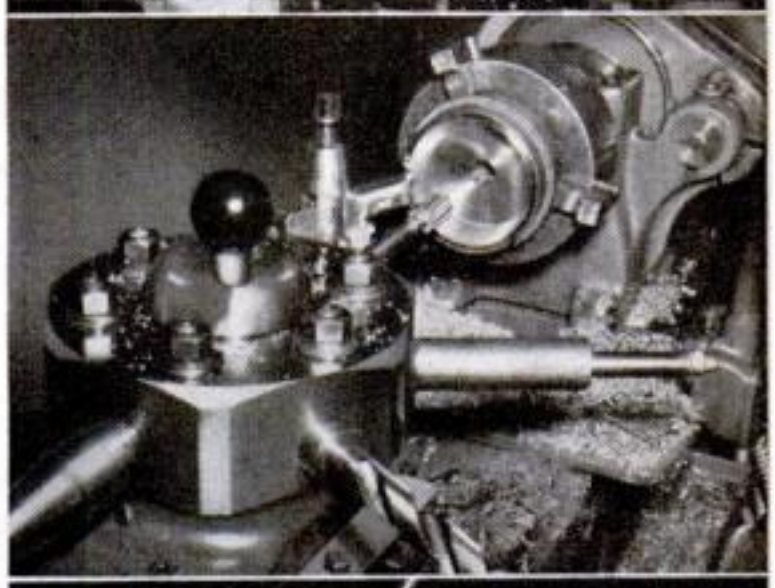
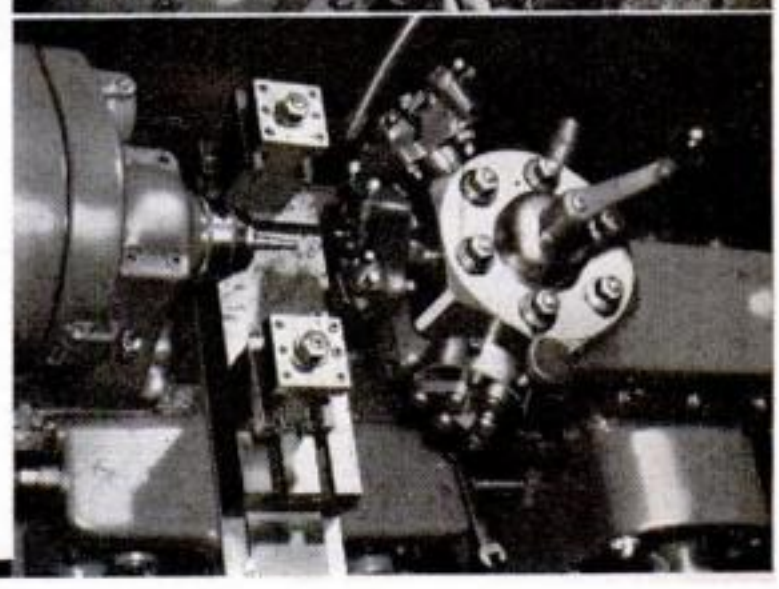


Awarded to the South Bend Lathe Works for outstanding performance in the production of Navy ordnance materiel.





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Standard extras include compound cross slide, four-way turret tool block, micrometer carriage stop, thread indicator dial and taper attachment. These attachments simplify tooling the lathe for many classes of work, and make it especially adaptable to second operation jobs.

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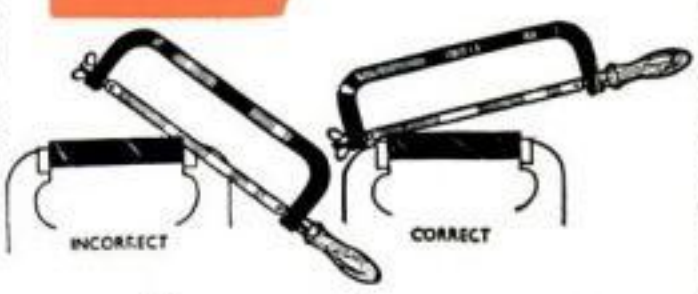

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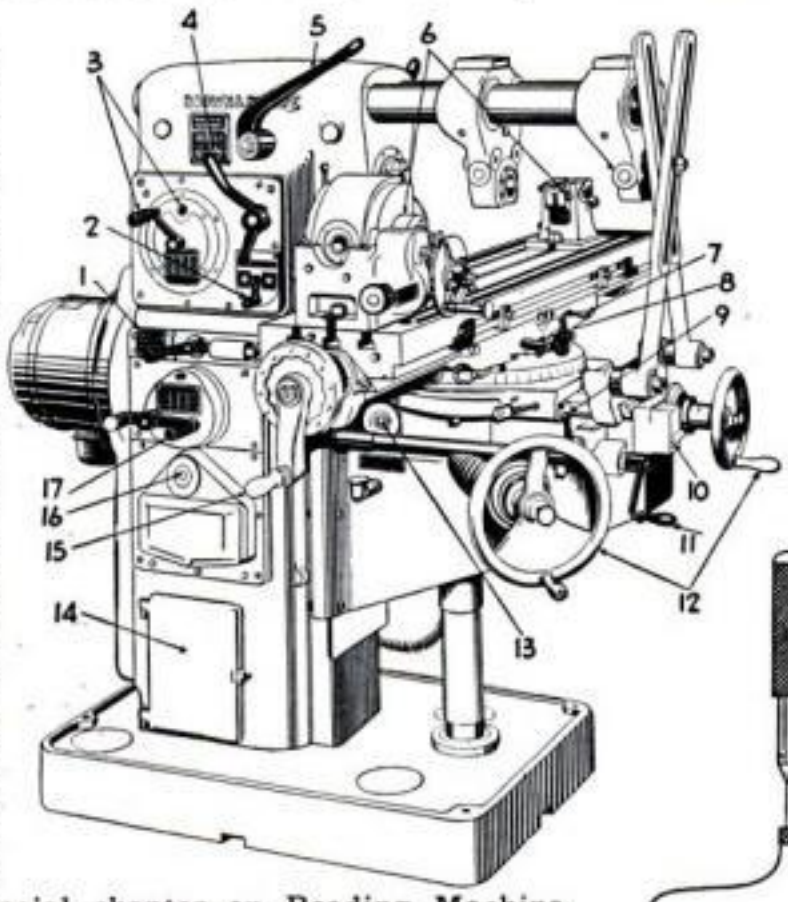
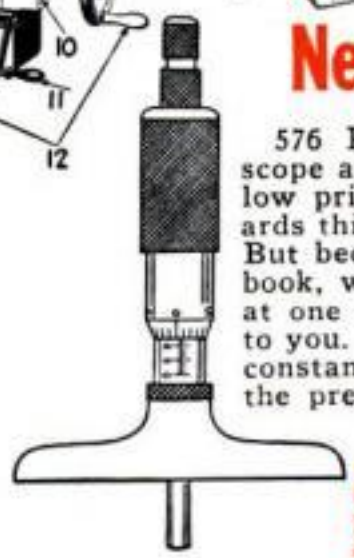
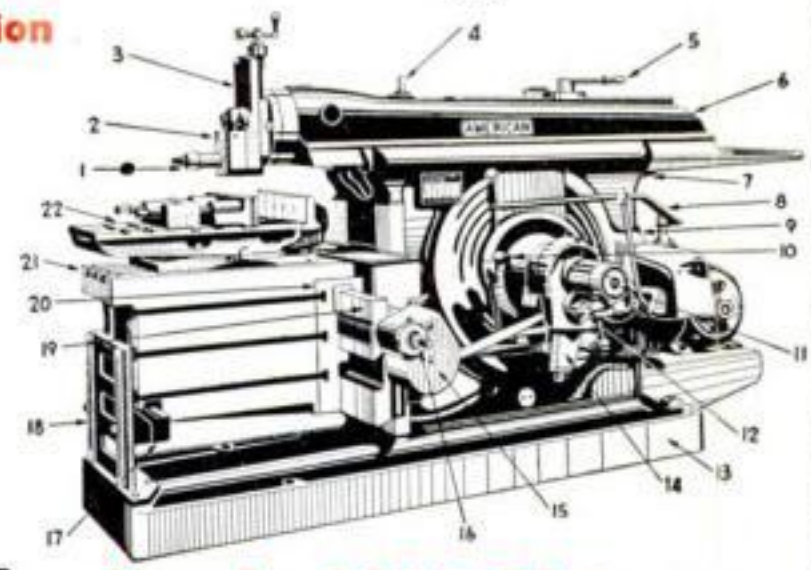
Covers Every Problem that Confronts Even the Expert Machinist

COMPLETE chapters in this volume are devoted to every type of Bench Work; different types of metal used by the machinist; Turret and Automatic Lathes, and their innumerable functions, attachments and operations. There are chapters covering every type of Screw-Cutting; Taper-Turning, Knurling; Milling and Grinding.

Included in the broad scope of this volume is full information on Special Machine Tools and Machine Attachments; Jigs and Fixtures; Punch Press Operations. Instruction is given in Heat-Treating of Metals; Welding and Soldering; Drop-Forging; Foundry Work; Gauging and Testing. Complete descriptions and explanations of all types of Calipers, Micrometers and other precision measuring instruments used by machinists are included. There is also a special chapter on Reading Machine Blue Prints. And there are dozens of tables designed to save time for the machinist and to simplify mathematical calculations.







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